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ABSTRACT

Four energy conservation concept areas are developed in this unit: (1) energy resources are many and varied and have evolved over a long period of history; (2) as much as 30 to 50 percent of the energy in the United States is wasted; (3) homes, offices, and schools account for 24 percent of total energy consumption and savings can be made through such methods as increasing home insulation; (4) transportation accounts for 25 percent of total energy consumption and savings can be made through such methods as reducing automobile size. Several activities accompany each of these concept areas. Each activity includes: the related concept; materials needed; suggested procedures; and expected results. Supporting documentation, including lists of informational services and publications (with addresses) are included in appendices. Although the unit is designed for junior high school students, it can be easily adapted to elementary and high school levels. (ML)

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# ENERGY WORKSHOP

Dr. Arie Halachmi, Director

## CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

By:

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Submitted as Partial Fulfillment of
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SE 045 810

# TABLE OF CONTENTS

Page

Page

# CONSERVATION OF ENERGY: HOME AND SCHOOL

## INTRODUCTION:

Because energy was cheap in the past, we have built inefficient cars, inefficient buildings, and inefficient factories and homes. Little thought was given to the fact that supplies of fossil fuels are very limited. Now, our very survival depends on the conservation of our present sources of energy and the development of new ones. Of all the options available to the country, conservation can be the cheapest and fastest means of decreasing our dependence on foreign oil. Through conservation, all Americans can participate directly in improving our energy position.

## OBJECTIVES:

1. To make students aware of the extent of the energy crunch.
2. To help students become more observant of the wasteful uses of energy.
3. To help students see how they can participate directly in improving our country's energy position.

## CONCEPTS TO BE DEVELOPED:

1. Energy resources are many and varied and have evolved over a long period of history.
2. As much as 30-50% of the energy consumed in the U.S. is wasted.
3. Homes, offices, and schools account for 24% of our total energy consumption. Savings can be made through:
   - A. Increasing home insulation
   - B. Using more efficient appliances
   - C. Better energy management.
4. Transportation accounts for 25% of our total energy consumption. Savings can be made through:
   - A. Reducing auto size and weight
   - B. Improving driving habits
   - C. Improving commuter habits
   - D. Encouraging mass transit.

## ACTIVITIES:

The following activities were created to meet the objectives and concepts above, primarily for grades 7-9. However, many are easily adapted for students in both elementary and high school. A general vocabulary/definition of energy terms list has been included which teachers may condense or enlarge as best fits individual teaching needs.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

2

**CONCEPT:** No. 1 Energy resources are many and varied and have evolved over a long period of history.

**ACTIVITY:** THINKING ABOUT ENERGY RESOURCES IN OUR HISTORY

**MATERIALS:** Copies of Activity for each student. See attached model.

**SUGGESTED PROCEDURE:**

Let students work individually on listing the 10 better-known sources of energy from our history. Pictures will provide clues to some.

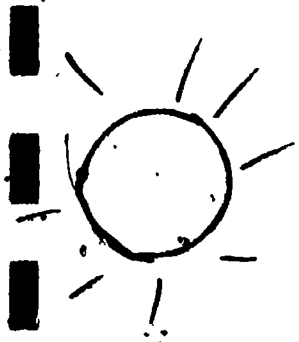
After this is done, students should try to work the grid puzzle using answers from their listing to successfully place appropriate letters in each block.

Lead a discussion as to the importance and significance of each for the present period.

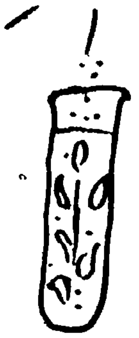
**EXPECTED RESULTS:**

Students will become more aware of past and present energy resources of the world and begin thinking of the future.

# ENERGY RESOURCES

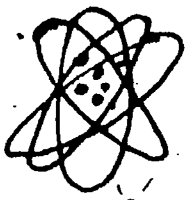


1. ____________________



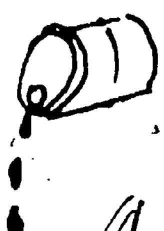
2. ____________________

3. ____________________



4. ____________________

5. ____________________

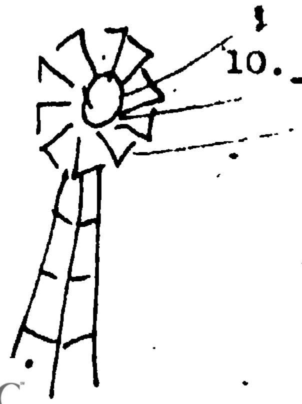


6. ____________________

7. ____________________

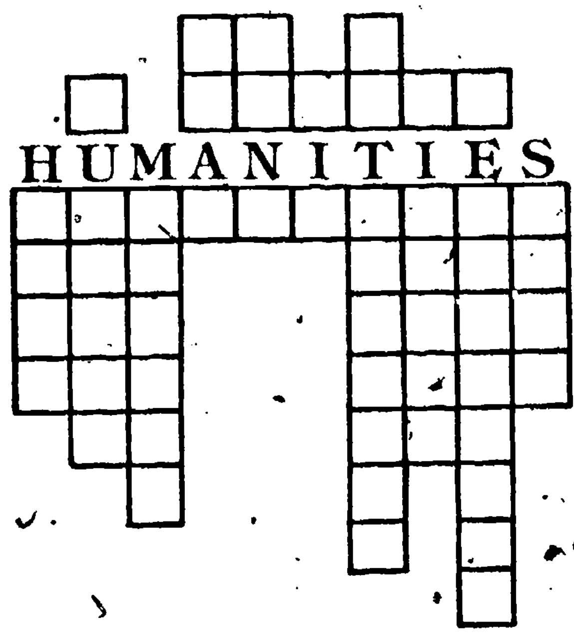
8. ____________________

9. ____________________

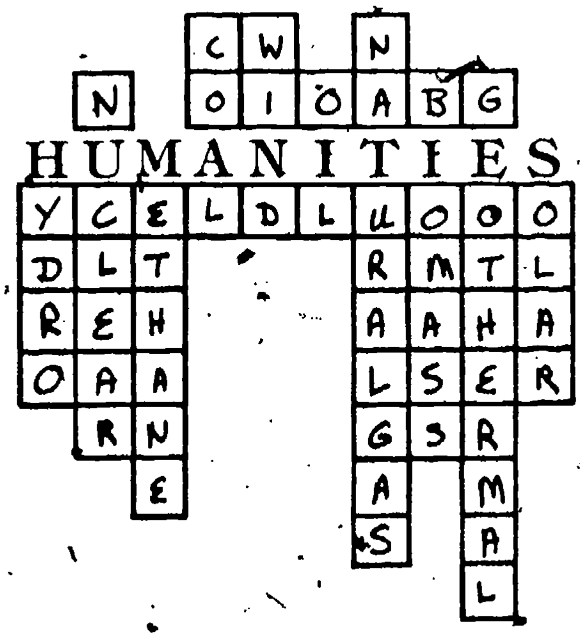


10. ____________________

## UP & DOWN ENERGY SOURCES




Fill in the squares vertically with energy sources, using the letters in the word "humanities" as clues. (Answer grid on page 15.) Students can create their own grids choosing other energy-related terms as the base. See who can make use of the most energy sources in one or two terms.



# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 1 Energy resources are many and varied and have evolved over a long period of history.

ACTIVITY: A. PRIMARY ENERGY SOURCES
B. WHERE WE GET OUR ENERGY; HOW WE USE IT!

MATERIALS: Students copies of attached two activities.

SUGGESTED PROCEDURE:

A. Discuss primary energy sources with children. Have them fill in the blanks in the four sections of questions.

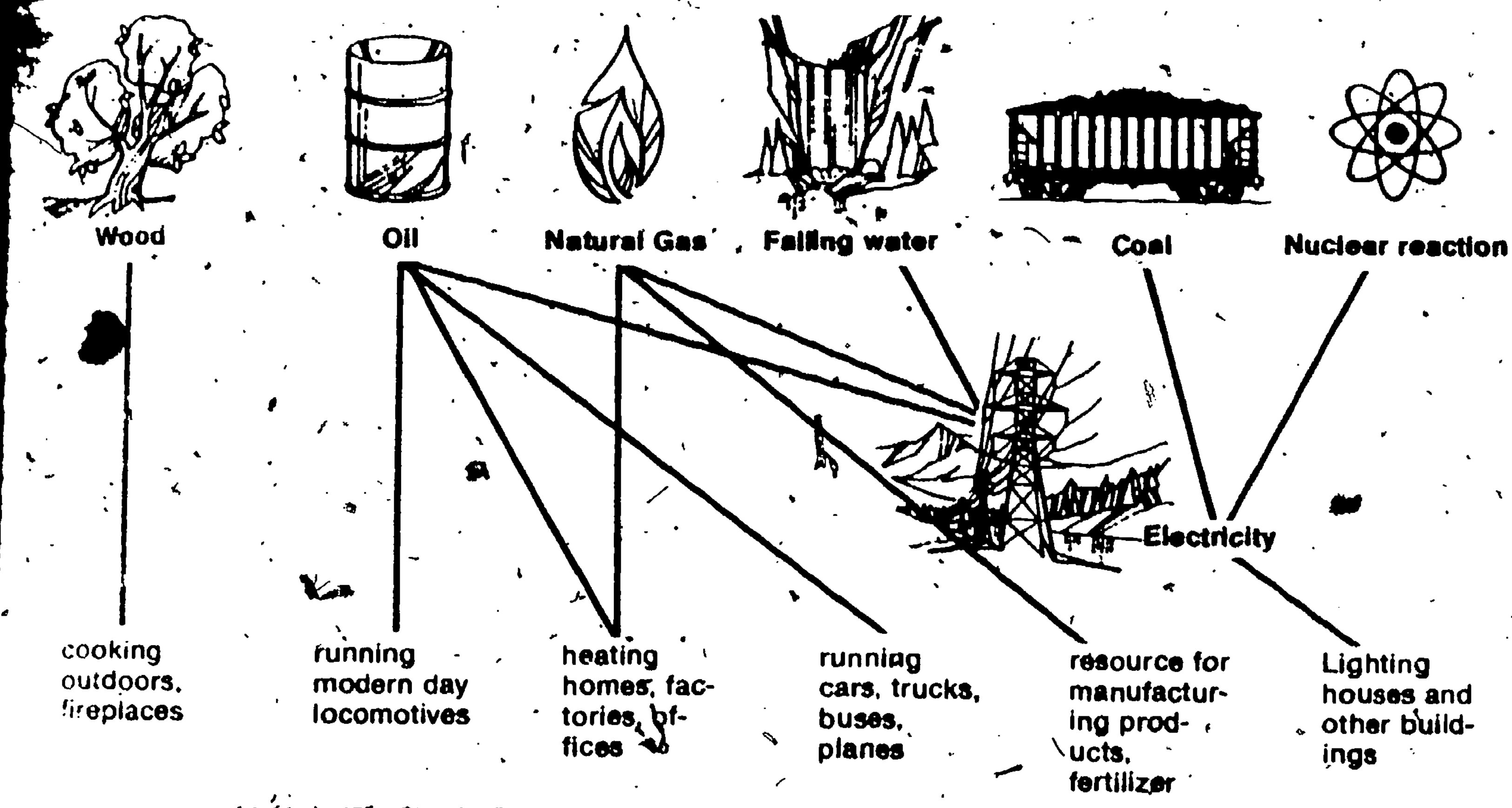
B. Have students study Graphs A and B and answer questions pertaining each.

Have students check appropriate colums in the 10 boxes.)

EXPECTED RESULTS: Students will learn about primary sources of energy, energy resource distribution and source expressed in percentages, and types of energy used.

Activity Master 3

# Primary Energy Sources




The diagram above shows six *primary sources* of energy. Lines connect each primary energy source to the most important work it does. Which energy source is seldom used today? wood Which two do not involve burning to produce power? Which ones are used to make electricity? natural gas; water; coal; nuclear

Use the information on the chart and on the energy timeline to help you complete these four stories about the Spritz family.

1. In 1901, Great-grandma and Great-grandpa Spritz went by train to Niagara Falls for their honeymoon. The train engine burned ______ to boil the water that made the steam that drove it. The *primary* source of energy was ______. Not long ago their great-grandchildren flew by jet to California. The primary energy source that got them there was ______.

2. Great-grandpa Spritz was one of the first in town to drive an automobile. His Model T burned ______. The primary source of this fuel is ______. A Spritz great-grandson earns his living driving a big diesel truck. The primary source of this fuel is ______.

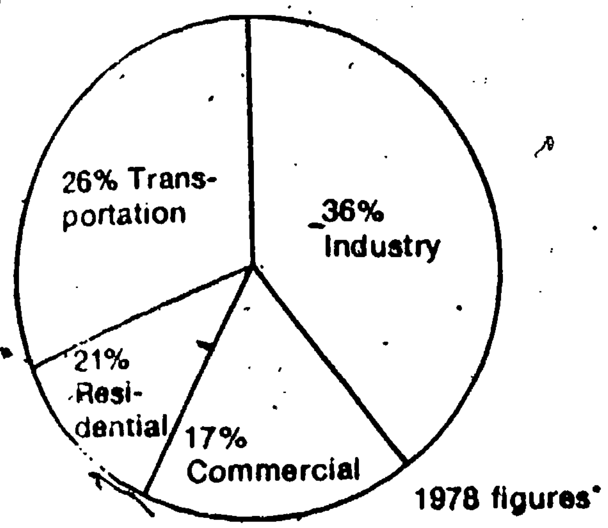
3. Four generations of Spritzes have lived in the old family home. At the turn of the century, the family huddled around a stove in the parlor for warmth. Probably the primary energy source was coal, wood. In 1928 the family put in central heating by installing a furnace in the basement. The primary energy source was coal.

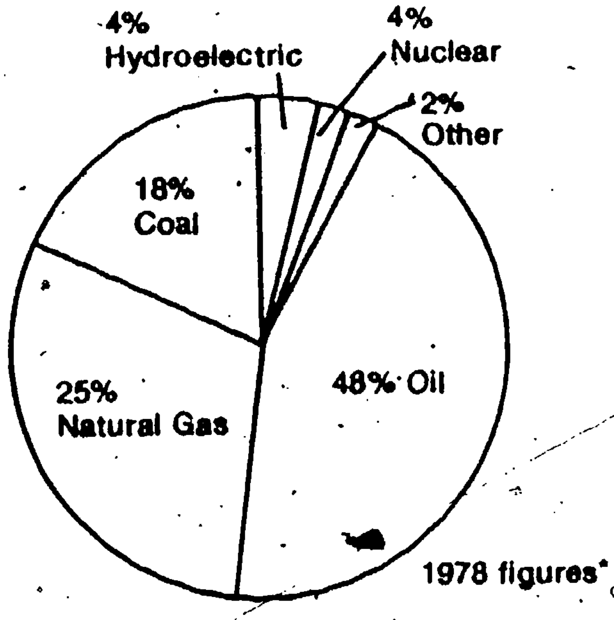
Since 1952 the Spritzes, like most Americans, have heated their homes with a primary energy source that is clean and convenient to use. It is natural gas.

4. Recently a young Spritz asked how the electricity that lights the house and runs the appliances is made. His dad drew a picture of a giant wheel with blades. "This is a turbine engine," he said. "There are a number of these at our city's power plant. These giant wheels turn to make electric energy. Falling water or powerful blasts of steam turn the wheels. You can't get steam, of course, without boiling water. And so a primary energy source furnishes heat to boil the water." The primary energy source that makes most of our electricity is coal. Other sources might be oil or natural gas or nuclear fuel.

Activity Master 4

# Where We Get Our Energy How We Use It




## GRAPH A

Graph A divides our energy use into four groups. In what group do we use the most energy? [illegible]
What ranks second? [illegible]
In what ways do you use energy in each of these two groups? What group(s) gives you the most opportunity to cut down on your energy consumption?

Which groups use energy when you do each of the following. Check the box or boxes in the appropriate columns.

(The first one is done for you.)

| | Industry | Transportation | Commercial | Residential |
|---|---|---|---|---|
| 1. Take a hot bath | | | | ✓ |
| 2. Drive to a hamburger stand | | | | |
| 3. Fly in an airplane | | | | |
| 4. Switch on air-conditioning | | | | |
| 5. Buy a new baseball | | | ✓ | |
| 6. Ride a school bus | | | | |
| 7. Blow dry your hair at home | | | | |
| 8. Buy a frozen pizza | | | | |
| 9. Ride a motor-bike | | | | |
| 10. Manufacture a motor-bike | | | | |

## GRAPH B

Graph B shows five primary sources of energy. These five sources supply Americans with most of their energy needs. They light and heat the buildings in which we live, work, and play. They fuel our vehicles. They run the machines that work for us and manufacture and process the goods we use and the foods we eat. Look at Graph B and answer these questions.

*Numbers may not total 100% because of rounding.*

1. What energy source do we use most?

2. Which do we use mostly for heating our homes? [illegible]

3. What energy source provides most of the fuel for our transportation?

4. Which one makes most of our electricity? coal

5. What is a possible reason why we use so little hydroelectric energy? [illegible]

6. Why is electricity not shown on this chart? [illegible]

CONCEPT: No. 1 Energy resources are many and varied and have evolved over a long period of history.

ACTIVITY: **FINISH THE ENERGY TIMELINE!**

MATERIALS: Student copies of Energy Timeline (see attached sheets)
Glue or paste, scissors.

SUGGESTED PROCEDURE:

1. Have students work individually on energy timeline.
2. After completion, go over answers. Discuss other pertinent events in American History occurring at the same intervals of time as on the timeline.
3. Cut timeline into indicated strips and glue or paste strips together to form timeline. Display.

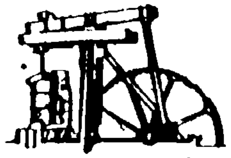
EXPECTED RESULTS: Students will develop an understanding of some of the important events in energy development history.

# *Finish the Energy Timeline*

Activity Master 1

cut

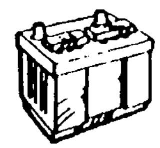
1780 1785 1790 1795



**1776**
In England James Watt puts two engines to work in factories & starts an energy revolution. The energy is ______.

**1783**
Two men fly in a balloon at ______.
The energy used is ______.

**Most people burn wood for heating and cooking and travel by horse or on foot.**

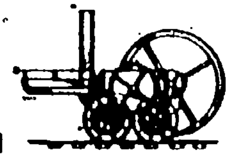


**1800**
In Italy, ______ invents the battery and gives his name to the volt. The energy produced is ______.

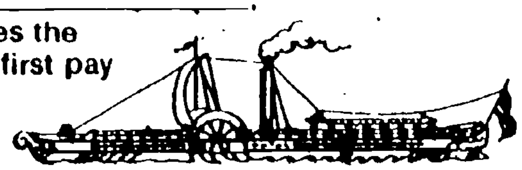
cut

1800 1805 1810 1815 1820 1825

**1804**
An Englishman, Richard ______ puts James Watt's engine on wheels and rails. He is the father of the railroad locomotive.



**1807**
Robert Fulton doesn't build the very first ______, but he makes the one people first pay to ride on.



**Wood continues to supply most household energy needs. But coal begins to do more in factories and railroad engines.**

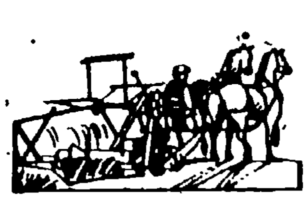
**1821**
First attempt to develop and market natural gas near Fredonia, N.Y.

cut

1830 1835 1840 1845

**1829** An American named ______ and an Englishman named ______ each invents a generator. Who is first? ______ The energy produced? ______

**1837** Americans put new inventions to work. First comes McCormick's ______, then the steam shovel by ______, and the telegraph by ______.

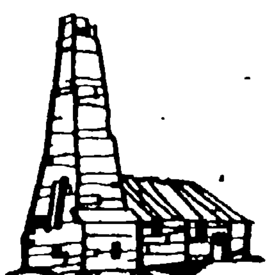


**Railroads expand rapidly, hauling freight and passengers brave enough to stand the jolts and to risk hot cinders that often fly from the engine into their cars. England is first and America second in railroad locomotive production.**

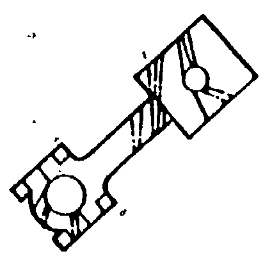
cut

1850 1855 1860 1865 1870 1875

**1859**
Edwin Drake strikes oil in Pennsylvania beginning the ______ industry.



**1860**
Lenoir of France invents the ______ combustion engine.



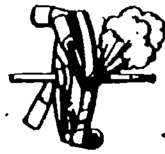
**An explosion inside a cylinder paves the way for the later invention of the automobile. An oil strike hastens the discovery of the fuel that will run it.**

cut

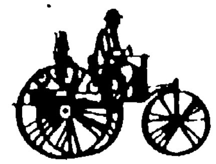
cut

1880 1885 1890 1895

**Coal and wood still furnish most of the energy in homes. Coal-fired "iron horses" (railroads) — and real horses — continue to take most people places. Although the electric bulb has been invented most people still use kerosene or gaslights to read by.**



**1884**
In England, Charles Parsons perfects the steam ________ and advances the development of electrical energy.



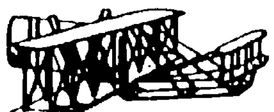
**1886**
Karl ________ builds the 1st successful automobile.

**1892**
The oil-burning engine is invented by ________. Eventually, this engine will replace steam-powered ones.

**1895**
The power of Niagara Fall is harnessed to make ________

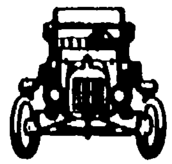
cut

1900 1905 1910 1915 1920 1925



**1903**
The engine in the Wright brothers' plane is powered by ________

**1905** Albert Einstein develops a theory for measuring energy and prepares the way for the ________ age.

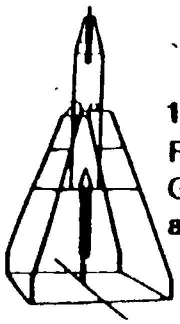


**1910**
Ford makes the first Model ____ car.

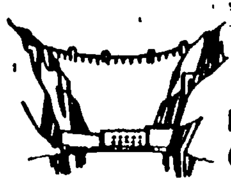
**By the end of this period, many new homes have coal furnaces in the basement. And more and more cars appear in garages.**

cut

1930 1935 1940 1945

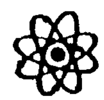


**1926**
Robert Goddard tests a ________



**1936**
Hoover Dam on the Colorado River is built to generate ________ power.

**1940**
________, a fiber made from oil, coal, and water makes its first public appearance.



**1942**
In Chicago, Enrico Fermi sets off the first ________ chain reaction.

**Many homes convert from coal to natural gas for heating. Most families own at least one car and some have two.**

cut

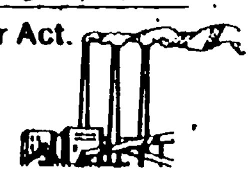
1950 1955 1960 1965 1970 1980

**1952**
Bell scientists raise hope for our energy future with the ________ battery.

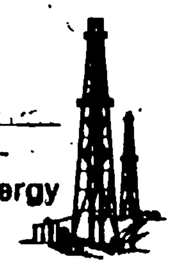
**1957**
The U.S. gets its first big ________ electric power plant at Shippingport, Pa.

**Demands for energy grow. America gets more people, more homes, more factories and businesses, more cars, more trucks, more buses, more planes. Demand grows faster than supply.**

**1970**
Congress passes the ________ Air Act.



**1973**
OPEC nations ________ oil and produce an energy crisis.



**1980** Americans continue to look for ways to ________ the energy we have and find new ________ sources.

cut

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

**CONCEPT:** No. 1 Energy resources are many and varied and have evolved over a long period of history.

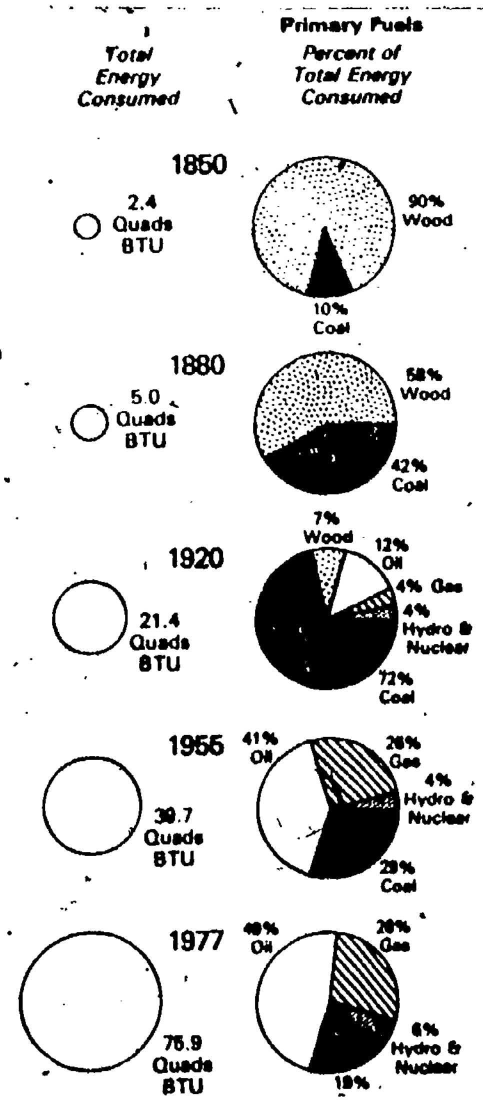
**ACTIVITY:** TRACING THE PATTERN OF U.S. ENERGY CONSUMPTION

**MATERIALS:** Copies of sample graphs for each student. Pencil and paper.

**SUGGESTED PROCEDURE:**

Have students study each of the graphs-pie charts. Help them interpret each and answer sample questions. Teacher may make additional appropriate questions.

**The Pattern of U.S. Energy Consumption**




Sample questions to be used with graphs.

1. What source had the greatest decrease in use from one time period to the next? Increase? Discuss why.
2. Our total energy consumption increased by what percentage between 1850 and 1977? By how many quads? Discuss the amount "quadrillion" in other quantities, e.g. dollars, acres, kilometers, jelly beans.
3. Should other categories (sources) be added to reflect our current energy use? Future use?
4. How do the charts reflect the country's general lifestyle and development?
5. Have each student list the sources used in his/her own home and then make a pie chart for the home's energy use. Do the same for the state.

**EXPECTED RESULTS:**

Students will be able to better understand past and present energy uses and needs.

CONCEPT: No. 1 Energy resources are many and varied and have evolved over a long period of history.

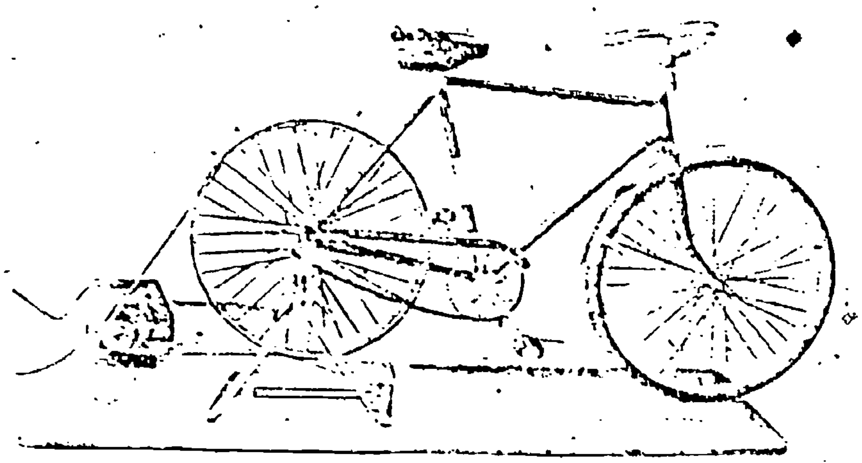
ACTIVITY: HOW TO BUILD A BIKE GENERATOR!

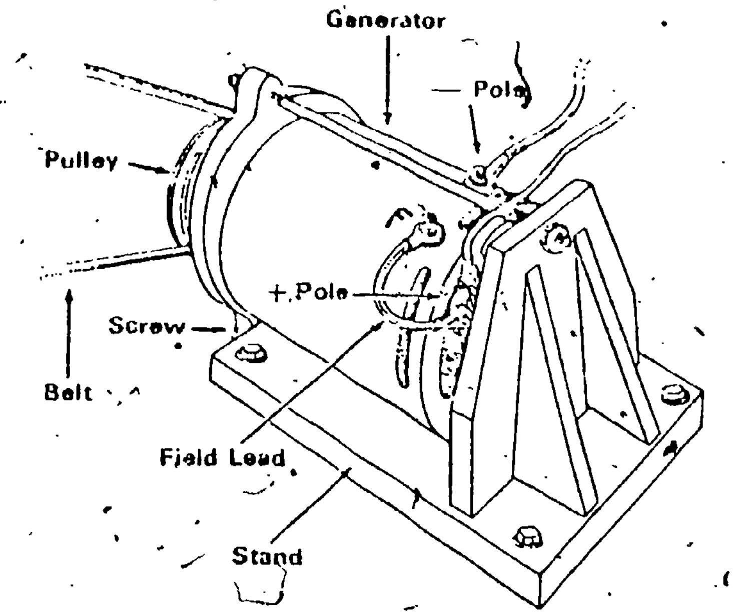
MATERIALS: See attached sheet.

SUGGESTED PROCEDURE: Follow instructions on attached sheet.

EXPECTED RESULTS: Students will learn how to build a simple generator which will put out enough electricity to power a light bulb.

# How To Build a Bike Generator






Do your students have lots of energy that they want to put to good use? Then build this bike generator.

EQUIPMENT NEEDED

- Car generator (from automotive supply store or garage)
- Bicycle
- Stand to support the rear wheel of the bike (Sold in stores; original purpose of stand is to change a bike into an exerciser.)
- Narrow belt 5½ to 6 feet in circumference (from a hardware store)
- Sheet of plywood 4 feet × 6 feet × ½ inch
- About 3 square feet of 1-inch-thick plywood
- Electrical wire
- One 9-inch carriage bolt
- Six 2-inch countersink bolts, washers, and nuts
- Three 1 inch screws
- 12 volt light bulb and holder
- Voltmeter (optional)

PUTTING IT ALL TOGETHER

*Building a Generator Base.* Screw an 8-inch × 12 inch piece of 1-inch plywood to a square (12-inch × 12-inch) plywood piece. The smaller piece should be lined up parallel to a side of the square piece and about 3 inches from the edge (see drawing above). Nail two triangular pieces to the smaller piece of plywood for support as shown.

Drill a ½-inch hole at the four corners. Bolts will be used later in these holes to fasten the generator base to the large 4-foot × 6-foot plywood sheet.

Place the generator so that the back end is next to the vertical piece of plywood and the pulley end of the generator is over the edge of the square base (see drawing). Screw the pulley end of the generator into the side of the square base.

Drill a hole through the vertical piece of plywood so that a long bolt can be threaded through the wood and through the two openings in the top part of the generator. Secure generator to vertical plywood by adding a washer and nut to the end of the carriage bolt, or at both ends if the bolt is headless.

If additional support is needed, two other triangular pieces can be added to the other side of the vertical piece of plywood after the wires have been connected to the generator.

*Connecting Generator to Bike.* Remove the rear wheel. Take the tire off and place the belt around the wheel. Put the wheel back on the bike and then place the bike's rear wheel on the stand. Drill a ½-inch hole through the center of each section of the stand resting on the floor. Then put the bike and stand on the 4-foot × 6-foot plywood sheet.

Attach the other end of the belt from the bike to the generator pulley. The generator must be positioned so that the pulley turns clockwise when the bike is pedaled.

Attach the wires to the generator leads as shown in the drawing above. The positive (+) or ground lead is at the rear of the generator. The negative (—) lead from the rotating armature is on the casing. Although this lead is generally not marked, it is next to another lead marked "F."

*Testing . . . One, Two . . .* Not all car generators are the same, so you will have to test the generator to make sure that it is turning correctly. Connect the other end of the leads to a voltmeter or to a 12-volt light bulb and holder such as those used in automobile tail lights. (The leads can be connected to the holder or, with the help of a shop teacher, soldered directly to the base and side of the bulb.)

Have someone pedal the bike while you hold the generator to the plywood to keep the belt taut and aligned. Watch the voltmeter (or bulb) to see if electricity is produced. If it isn't, change the field lead so that it is connected to the negative pole rather than to the positive lead. This will probably solve the difficulty.

If not, turn the generator around so that the pulley turns in the opposite direction, and then vary the field connections as mentioned earlier. The person pedaling will know when electricity is being produced because the bike will become hard to pedal.

*Almost Finished.* Once you are sure the generator is working properly, carefully align the belt on the wheel and pulley. The belt should be reasonably tight and should ride in the middle of the wheel and pulley when they are turning.

Mark the positions of the holes in the bike stand and generator support on the 4 × 6-ft plywood sheet. Drill ½-inch holes through the plywood, countersink the bolts, and bolt the bike stand and generator support firmly to the base. To make fine adjustments in the belt alignment, it would be better to have short slots rather than holes for the bolts used with the bike stand. The stand can then be moved slightly right or left to obtain better belt alignment.

The bike generator is now ready for student use and experimentation. Generate that power and tell us how you use it. Maybe you'll earn one of our super Awards.

CONCEPT: No. 1 Energy resources are many and varied and have evolved over a long period of history.

ACTIVITY: LEARNING ABOUT THE TENNESSEE VALLEY AUTHORITY

MATERIALS: Maps of the Tennessee Valley region, colored pencils, pens. Pencil and paper for answering of questions.

SUGGESTED PROCEDURE:

I. Provide students with maps of the Tennessee Valley region and have them locate and label one or more of the following groups:

A. Hydroelectric dams
B. Steam Plants
C. Nuclear plans
D. Tennessee River and major tributaries
E. States in the TVA region of service

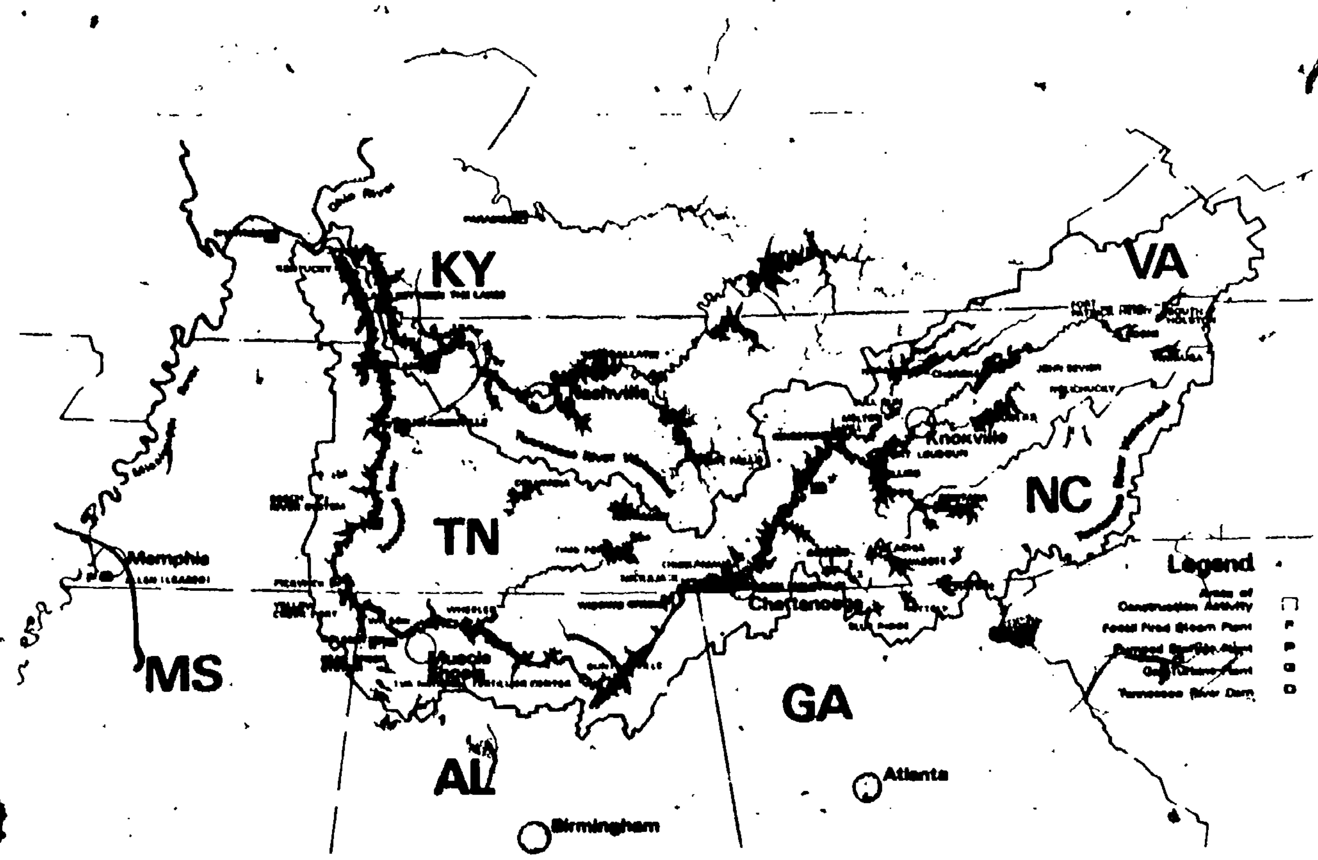
II. After studying TVA materials, have students answer appropriate questions concerning it.

(See attached sample list.)

EXPECTED RESULTS: Students will become familiar with TVA, what it is, what it is doing, its functions, and how the federal government has been involved in this project.

## TENNESSEE VALLEY AUTHORITY

1. What is TVA?
2. When and how was TVA created?
3. What are the basic objectives of the Act creating TVA?
4. What states make up the TVA region?
5. By whom are the top affairs of TVA administered?
6. How are they chosen?
7. What are employment totals for TVA?
8. What employment opportunities are available at TVA for young people
9. Why are TVA dams called multiple-purpose dams?
10. How many dams are in the Tennessee Valley water control system?
11. Why do TVA lake levels fluctuate?
12. How do TVA reservoirs reduce flood damages?
13. Which TVA dams have navigation locks?
14. Why did Congress authorize TVA to generate and sell electricity?
15. What power facilities does TVA operate?
16. Why are steam plants needed?
17. How much coal does TVA use in its steam plants?
18. Why are nuclear plants used?
19. How is TVA power distributed?
20. Why do rates keep going up?
21. Does the American taxpayer pay for the TVA power system?
22. How much is invested in the TVA power system?
23. Is TVA involved in the research and development of new energy sources?
24. Why does TVA urge energy conservation?
25. What recreation facilities are located on TVA lakes?
26. Is TVA concerned with environmental issues?
27. What does TVA do tohelp communities plan for the wise use of their land, air, and water resources?
28. What is TVA's "Fertilizer program"?



CONCEPT: No. 1 Energy resources are many and varied and have evolved over a long period of history.

ACTIVITY: BIOGRAPHICAL RESEARCH - ENERGY CONTRIBUTORS

MATERIALS: Pencil, paper. Source materials on famous contributors to the field of energy. Library facilities.

SUGGESTED PROCEDURE: HHave students select one or more of the following well-known contributors to the field of energy. Reports may be given orally or in written form:

- Thomas Savery
- Thomas Newcomen
- James Watt
- Richard Trevithick
- Oliver Evans
- Robert Fulton
- Edwin Drake
- Albert Einstein
- Lenoir - France
- Volta - Italy
- Charles Parsons
- Robert Goddard
- George Stephenson
- Siegfried Marcus
- Gottlieb Daimler
- Nicholaus August Otto
- Enrico Fermi
- John Erickson
- Robert Oppenheimer
- Joseph Henry
- Michael Faraday
- Karl Benz
- Rudolpf Diesel
- Henry Ford

EXPECTED RESULTS: Students will learn more about prominent individuals who have made contributions to the field of energy.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: ENERGY QUESTIONS

MATERIALS: Student copies of charts and questions

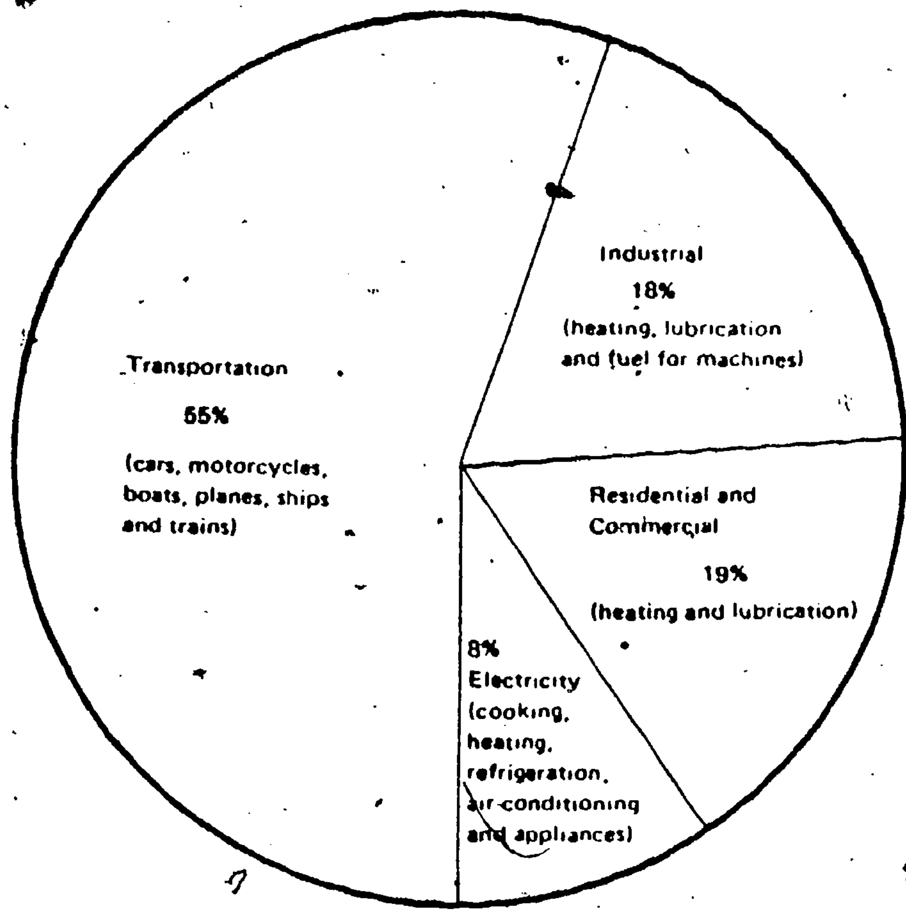
SUGGESTED PROCEDURE:

Have students study both chart and picture and answer questions.

Discuss correct answers with students afterwards.

EXPECTED RESULTS:

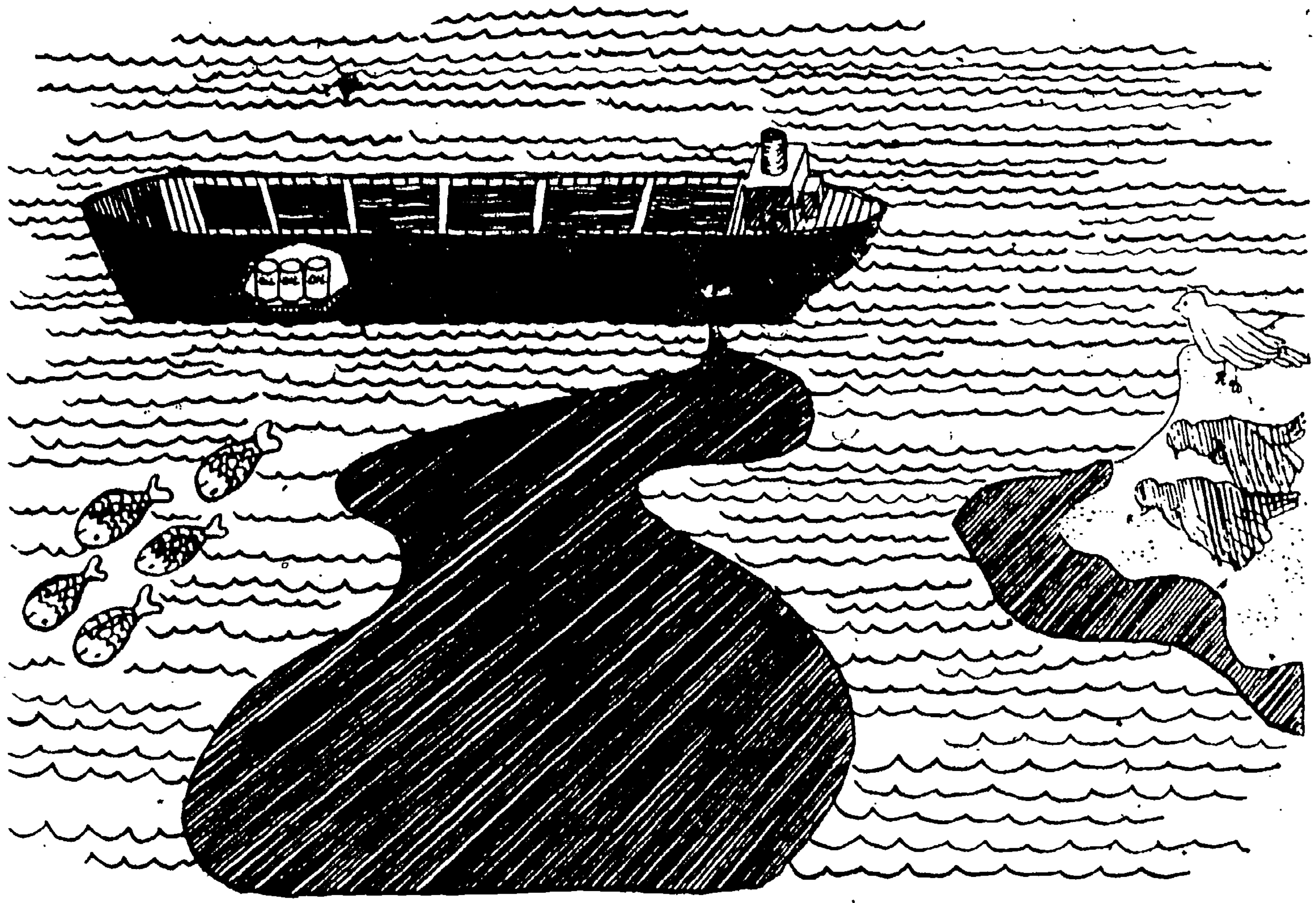
Students will learn about the division of energy use in the U.S. and other general information about energy.




______ 1. Which user has the greatest dependency on oil?
a. Industry
b. Transportation
c. Residential and Commercial
d. Electricity

______ 2. The information on this diagram shows
a. the part of every tax dollar that is spent for Americans' energy needs.
b. the categories for fuel consumption in the United States.
c. how much oil the United States imports each year.
d. the environmental effects of oil use.

Look at the picture, then decide whether these statements are true (T) or false (F).



_______ 3. Oil spills affect coastal waters even more than deep ocean waters.

_______ 4. An oil spill means money lost to someone.

_______ 5. The picture shows energy is being transported.

_______ 6. A national speed limit could have an effect on what is shown in the picture.

_______ 7. It takes energy to transport energy.

_______ 8. Conservation of gasoline would mean we would have to import less oil.

Choose the best answer for the following question.

_______ 9. Reduce the average speed of automobiles and you will reduce all the following EXCEPT
a. the need for tanker ships of oil from other places
b. the amount of pollutants in the air
c. the number of highway deaths
d. the need for automobile factories

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: TEST YOUR E.Q. (Quiz)

MATERIALS: Student copies, pencils.

SUGGESTED PROCEDURE:

1. Have students work individually on quiz.
2. Go over quiz with students.

This quiz can be used as a pre-test if desired before getting into depth into energy education.

EXPECTED RESULTS:

Students will begin to think more seriously about energy education and see that there is a lot to think about and learn.

# Test Your E.Q.*

Take this quiz to check your knowledge and understanding of energy-environment issues. When you have marked your answer, turn to page 24 to see how well you have done.

1. ____ How much of the energy used in gas stoves supplies the pilot lights?
   a. 10%
   b. 25%
   c. 50%

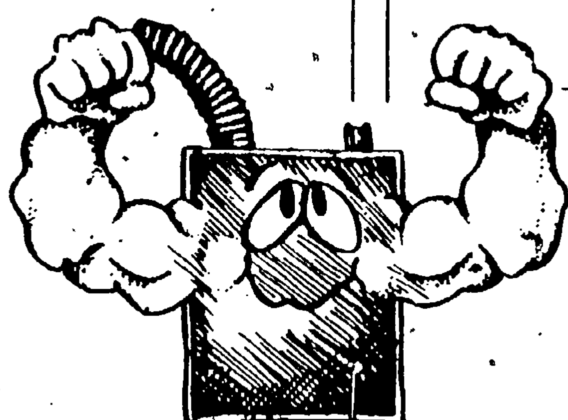
____ 2. An incandescent lamp and a fluorescent lamp have the same light output: Which uses energy more efficiently?
a. fluorescent
b. incandescent
c. both about the same efficiency

____ 3. How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?
a. three
b. five
c. twenty

* *Energy Quotient.*

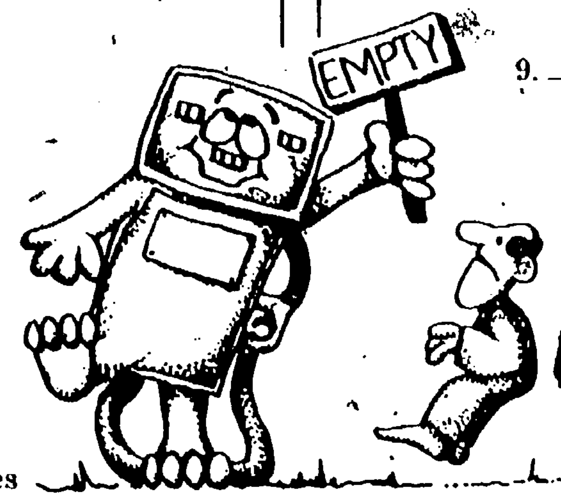
____ 4. How much heating oil would be saved on a typical winter day if the attics of single family homes that needed insulation were properly insulated?
(a) 2%
(b) 8%
(c) 50%

____ 5. How much of the energy stored in crude petroleum is lost between the oil well and a moving car?
a. 20%
b. 60%
c. 90%



____ 6. The heat energy of a gallon of gasoline is equivalent to
a. 5 man-days of labor
b. 15 man-days of labor
c. 25 man-days of labor

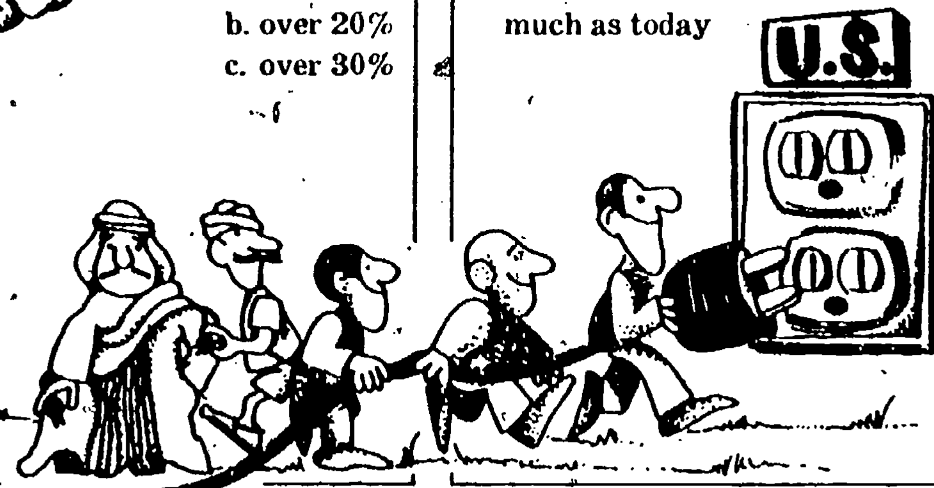
____ 7. How much faster than their rate of production are we consuming our fossil fuels?
10 times
b. 1,000 times
c. 1,000,000 times




____ 8. What fraction of the world's energy consumption occurs in the U. S.?
a. over 10%
b. over 20%
c. over 30%

9. ____ Which of the following fuel resources is in greatest danger of exhaustion?
a. coal
b. petroleum
c. natural gas

____ 10. In the year 2000, American total energy demand will be:
a. the same as today
b. twice as much as today
c. three times as much as today



Score 1 for each correct answer.
0—5 Poor, 6—7 Fair, 8—10 Good.

ANSWERS:

1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.
2. (a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescent light gives more light than *three* 60-watt incandescent bulbs (and the annual savings may be as much as $10).
3. (c) Aluminum is a very energy intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers equivalent energy waste is equal to the output of 10 large nuclear power plants.
4. (b) If attic insulation were added to the 15 million single-family homes that need it, it would save about 8 percent of the heating oil previously used on a winter day.
5. (c) Ninety-four percent of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

| | |
|---|---|
| producing the crude oil | 96% |
| refining | 87% |
| gasoline transport | 97% |
| engine thermal efficiency | 29% |
| engine mechanical efficiency | 71% |
| rolling efficiency | 30% |

The total efficiency of the system is found by multiplying the six factors together: 6%.

6. (b) 15 man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of a man at hard labor for 2 years.
7. (c) In less than 500 years man will have consumed essentially all of the coal, oil, and gas that nature started forming 500,000,000 years ago. By comparison, that same fraction of a calendar year is approximately 30 seconds.
8. (c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.
9. (c) Natural gas reserves in the U. S. are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.
10. (b) For more than a century, American demand for energy has doubled, on the average, every 20-25 years.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

20

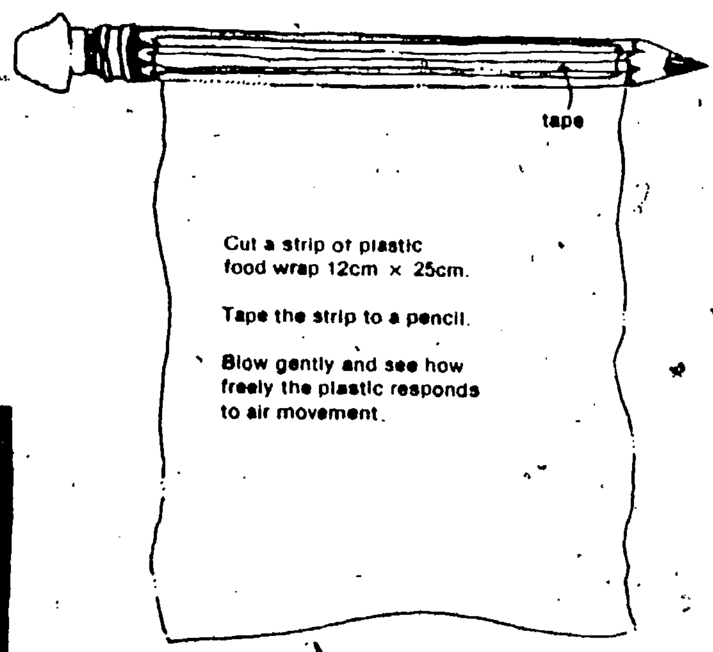
CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: Use the draftometer to see where air goes in and out

MATERIALS: Pencil, Plastic Wrap, Tape

SUGGESTED PROCEDURE:

Make a draftometer like this one.




Note: A forced air furnace must be off to use a draftometer or you will get false drafts.

Hold it up in front of the windows to check the direction of drafts.

EXPECTED RESULTS:

Students will have an easy and inexpensive way to check for drafts in various locations of homes, buildings, schools.

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY:

A. WHAT CAN YOU DO TO SAVE ENERGY?
B. IT'S EVERYONE'S JOB!

MATERIALS: Student copies of the two activities attached.

SUGGESTED PROCEDURE:

Have students follow the directions given for each activity.

Go over activities after completion and lead discussion about different aspects of energy conservation.

EXPECTED RESULTS:

Students will think of ways to conserve energy in a variety of ways and learn how to plot energy consumption on a graph.

Activity Master 17

# What Can YOU Do To Save Energy?

Part 1:

Brenda's mother and Wayne's father each work ten miles away from their homes. In a five-day week, each uses five gallons of gas driving to and from work. Wayne's father drives alone. Brenda's mother is in a car-pool in which she takes four other persons to work. If each of her passengers drove, each would also use five gallons of gas a week. Now that they car-pool, how much gasoline does Brenda's mother help save each week? ______________________

each year? ______________ How could Wayne's father help save energy? ______________________

The Bailey's are going away on vacation. They are concerned about burglars and want a light on in their house from 7:30 to 11 o'clock each evening. Can you suggest how they might do this without wasting energy? ______________________

Selecting the right size electric light bulb can help save energy. On the package is listed the number of watts (the amount of power needed to make the light bulb work), the lumens (the brightness of the bulb), and the number of hours the bulb will last. With this information, how could you select the most efficient bulb? ______________________

______________________

______________________

John and his sister are going to wash clothes. He wants to do his three shirts separately. His sister wants to do them with her five blouses. Which way will conserve energy? ______________________

______________ Why? ______________

______________________

Jack has just come indoors after skating on the pond and feels cold. He wants to turn the thermostat up to 80° F. His mother tells him to leave it where she has set it at 68° and put on a sweater. Who is more energy-conscious? ______________________

Why? ______________________

______________________

______________________



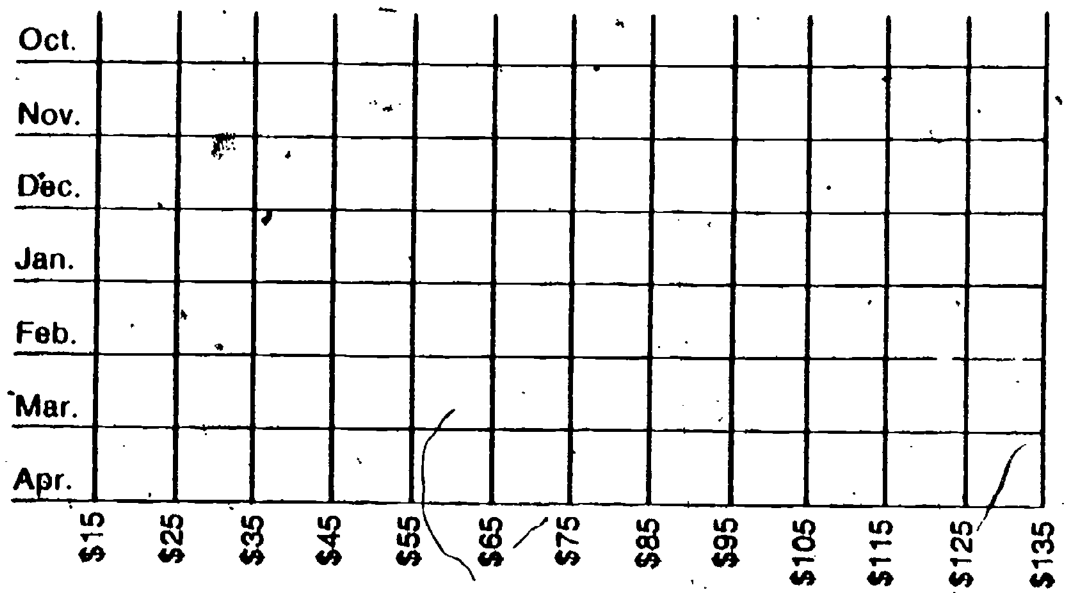
Part 2:

Below are the Hazleton's heating bills for two different years. During the first year, they had no insulation in their 1800 sq. ft. home. At the end of the year they had their house fully insulated, so the cost of heating their home went down. On the graph below, place a dot for the cost of each heating month of the first year. Then draw a black line between the dots. Do the same thing in red for the following year. Compare the Hazleton's savings with insulation.

How much did they save in January? ______________

How much for the entire heating season? ______________

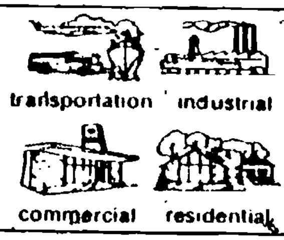
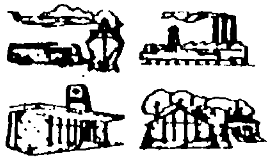
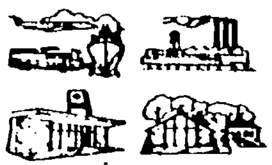
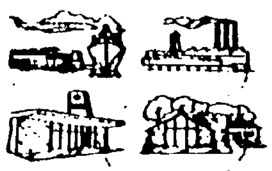
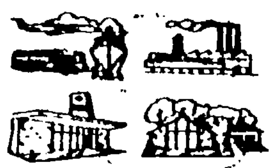
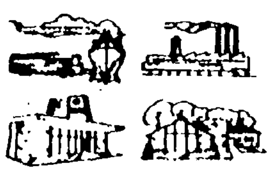
| | First Year | Following Year |
|---|---|---|
| October | $24 | $20 |
| November | $61 | $45 |
| December | $98 | $70 |
| January | $135 | $95 |
| February | $116 | $80 |
| March | $98 | $70 |
| April | $73 | $50 |




Do you think insulation would help to lower air-conditioning bills? Why or why not? ______________________

# *It's Everyone's Job!*

Read the idea for conserving energy in the column headed **Conservation Method**. Then answer the questions in the spaces provided.

| **Conservation Method** | **What sector of society? (circle one or more)** | **What energy resources does this save? (write: natural gas, petroleum or coal)** | **Does it use less energy? (Yes or No)** | **Does it use energy more efficiently? (Yes or No)** | **How can we encourage this conservation measure? (brainstorm as many ideas as you can)** |
|---|---|---|---|---|---|
| Flying passenger airplanes only when they are full |  | | | | |
| Shipping freight by train instead of truck |  | | | | |
| Replacing incandescent light bulbs with fluorescent lights |  | | | | |
| Reducing heating and cooling where space is unoccupied |  | | | | |
| Recycling steel, paper, glass, aluminum |  | | | | |
| Developing and using mass transit systems |  | | | | |



23

**CONCEPT:**

No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

**ACTIVITY:**

ENERGY PROVERBS!

**MATERIALS:**

Set of "proverbs," 3 x 5 cards, pencil, paper, magic markers, light colored construction paper, pictures from magazines or photographs, scissors, glue or paste.

**SUGGESTED PROCEDURE:**

1. Print interesting "proverbs" on 3 x 5 cards (These can be taken from Bible, Poor Richard's Almanac, or a number of other sources.)

2. Have students rewrite proverbs using energy conservation tips. These may be printed on the cards or placed on construction paper and illustrated with pictures, etc.

Example: "A clean chimney keeps the house entire."

"Twenty less trips saves a barrell of oil a day."

A stitch in time saves nine.
An apple a day keeps the doctor away.
A penny saved is a penny earned.
You can't teach an old dog new tricks.

3. Create an energy bulletin board from student efforts.

**EXPECTED RESULTS:**

Students will think of interesting and clever ways to express energy conservation.

**CONCEPT:** No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

**ACTIVITY:**

# WHICH BOILS FASTER: WATER IN AN UNCOVERED PAN OR A COVERED PAN?

**MATERIALS:**

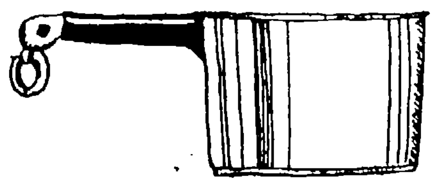
- Hot plate
- Pan with lid
- Watch
- Water
- Styrofoam cups
- Metric measuring cup

**SUGGESTED PROCEDURE:**

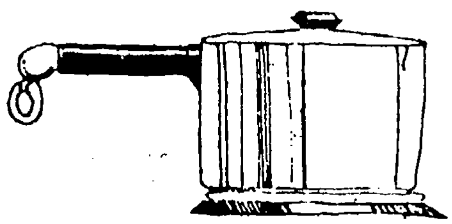
1. Turn on the hot plate.

   Add 500 ml of cold water — no lid.

2. Place the pan on the hot plate, and start timing. How long does it take for the water to boil vigorously?



3. Empty the pan and let it cool. Add 500 ml of cold water and cover the pan. Begin timing when you put it on the hot plate. How long does it take to boil the water?



*Record:*

| | boiling time |
|---|---|
| uncovered pan | |
| covered pan | |

**EXPECTED RESULTS:**

The student will be able to determine why covering the pan saves energy.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: CASH FOR TRASH - Recycling Waste Materials Project

MATERIALS:

Aluminum Cans
Bi-Metal Cans
Newspapers
Plastic Soft Drink Bottles
Glass Bottles (Non-Refillable)

SUGGESTED PROCEDURE:

Have students collect materials for recycling. Can be undertaken as a class project or for school-wide participation.

See attached ad for details.

EXPECTED RESULTS: Students can see the benefits of recycling waste materials and receive monetary benefits as well!

SAVE

# CASH

# FOR

# TRASH

Announcing the newest innovation in recycling—**drive-thru,** one-step, multi-material buy back recycling centers. These new centers are conveniently located in Kroger parking lots throughout the Nashville area.
The materials which will be accepted are as follows:

- **ALUMINUM CANS**-Relatively free of dirt and other contaminates. (Separated)
- **BI-METAL CANS** (ALUMINUM STEEL)-Relatively free of dirt and other contaminates. (Separated)
- **NEWSPAPERS**-Bundled or in grocery bags. (No Magazines)
- **PLASTIC SOFT DRINK BOTTLES**-Clean and free of caps.
- **GLASS BOTTLES** (NON-REFILLABLE)-Metal free and color sorted.

RECYCLE USA RECYCLE RECYCLE

## 143 McGavock Pike
## Donelson

RECYCLE USA RECYCLE RECYCLE

## RECYCLE
## CENTER HOURS:

**MONDAY THRU SATURDAY 9 A.M.-5 P.M.**

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

**CONCEPT:** No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

**ACTIVITY:** LEARN TO READ YOUR ELECTRIC METER!

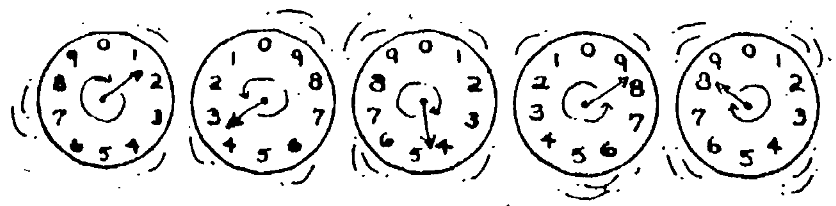
**MATERIALS:** Pencil, Paper. Charts showing examples of meters. Home electric meters.

**SUGGESTED PROCEDURE:**

1. Use the suggested meter charts and explain how to read the meter. Give practice examples.
2. Read the meter at your home.
3. Record the readings for 2 days. Subtract: how many kilowatt hours did you use. How does this compare with other families?

After studying conservation techniques, students may wish to chart their own home usage over several weeks or months to see conservation success.

HOW TO READ YOUR ELECTRIC METER



Read the dials from right to left and copy the numbers in the same order.

When the indicator lies between two numbers, record the number it just passed. (It will always be the smaller number!)

The number above would be recorded like this: 13488 !

Note: The teacher should have each student make a model meter with movable hands or make one large meter for the whole classroom to practice reading.

**EXPECTED RESULTS:** Students will learn to read electric meter and understand the meaning of Kwh - kilowatt hour. They should become more conservation-conscious in their own homes.

CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

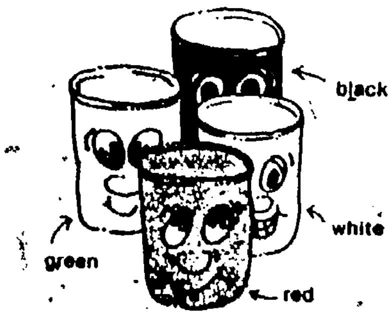
ACTIVITY:

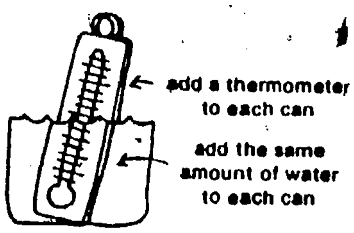
MATERIALS:

SUGGESTED PROCEDURE:

## WHAT COLOR HOLDS HEAT LONGEST?

**MATERIALS:**
4 Juice cans
Spray paint: white, black, green, and red (or any other contrasting colors)
Hot water (close to boiling)
4 Thermometers; food colors




Paint each can a different color.
Fill each can with the same amount of hot water (at least 40°C).
Add black water to all cans. (mix drops of all colors together to get black)
Put a thermometer in each can.

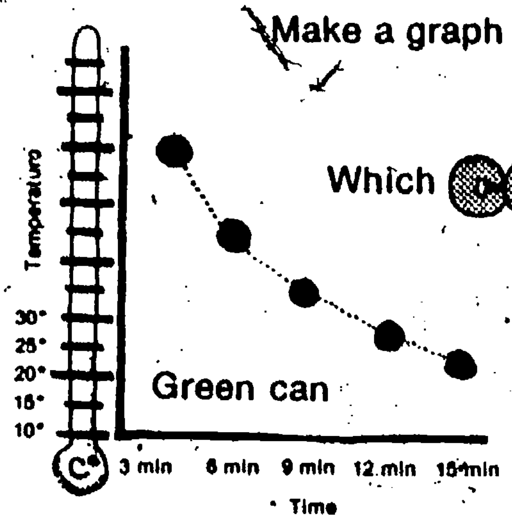
Record the water temperature in each can.

| colors | starting temperature | 3 min | 6 min | 9 min | 12 min | 15 min |
|---|---|---|---|---|---|---|
| white | | | | | | |
| black | | | | | | |
| green | | | | | | |
| red | | | | | | |

Record the temperature every 3 minutes until the water cools to about 20°C.

EXPECTED RESULTS:

Students may perform experiments which will help them better understand the effects of various colors in relation to heat retention.

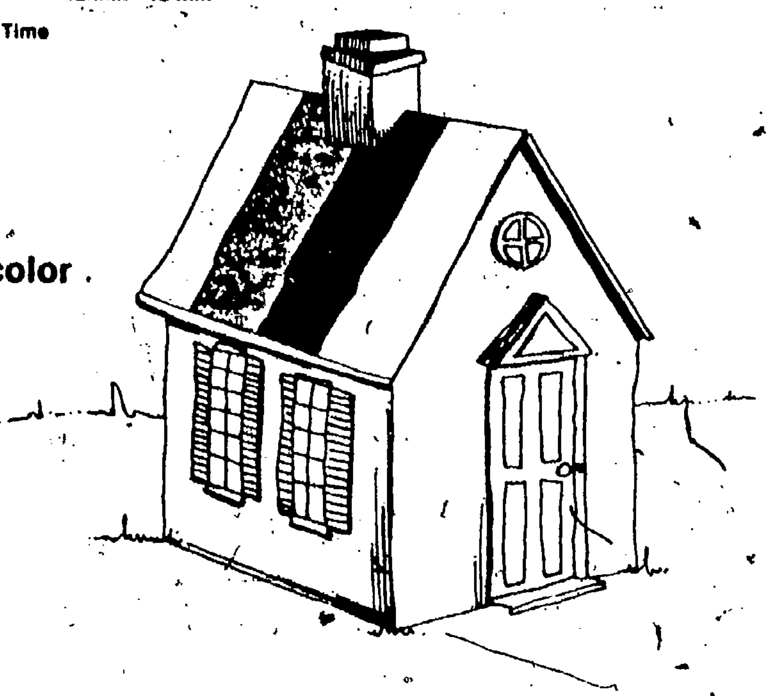



Make a graph of the results for each color.

Which **COLOR** held heat best?

**Summary question:**

**What is the best color to paint a house to keep it warm in winter?**



## OTHER IDEAS TO EXPLORE:

Which cup of coffee will lose heat faster – a cup of black coffee or a cup of coffee with cream in it?

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

**CONCEPT:** No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

**ACTIVITY:**

## WHAT'S THE BEST INSULATOR?

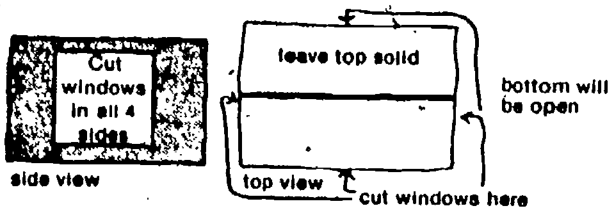
**MATERIALS:**

### MATERIALS:

100 Watt bulb in ceramic socket—see drawings below
A variety of insulating and non-insulating materials such as wood, aluminum foil, fiberglass (7.5cm-10cm thick), glass, metal, newspaper, heavy cloth, etc.
4 Thermometers; cardboard box; watch
Masking tape; knife

**SUGGESTED PROCEDURE:**

Set up the box like this:

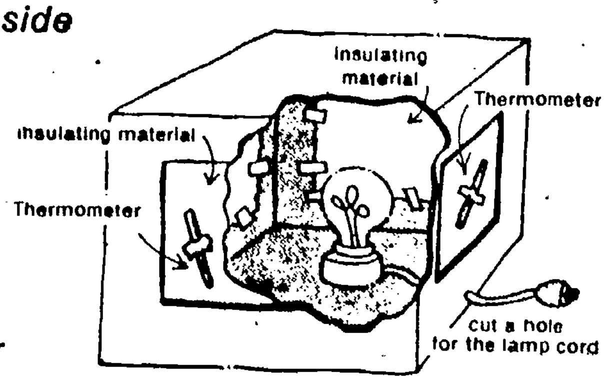



Tape four insulating materials over the windows on the *inside* of the box.

Tape a thermometer to the *outside* of each insulating material.

Record the starting temperatures.

Place the light in the center of the box.




Turn the lamp on for 5 minutes.

Record the rise in temperature for each material. How much better is the best insulator compared to the worst?

**EXPECTED RESULTS:**

Students will be able to experience first-hand experiments which will help them better understand properties of various materials in relation to insulation.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

**CONCEPT:** No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

**ACTIVITY:** THE FEDERAL GOVERNMENT WORKS TO EASE THE ENERGY CRISIS!

**MATERIALS:** Research materials for students to use to learn more about various federal energy agencies, programs, and legislation.

a. Copy of the Office of Technical Assessment's Analysis of the Proposed National Energy Plan - 1977 (Carter Adm.)
b. "Making Energy Regulations" - U.S. Dept. of Energy
c. "A New Start: The National Energy Act" - U.S. D.O.E.

**SUGGESTED PROCEDURE:**

1. Have students assigned to work individually or in groups on the various listings given.

2. Have them report orally on their findings. Written reports may be turned in also.

3. Discuss the 7 major energy goals of President Carter. Use Chapter 12, Issues 5-12, in developing this.

4. Have students check recent newspapers, magazines, to become better aware of President Reagan's energy plans, especially in conservation.

**EXPECTED RESULTS:** Students will become far more knowledgeable of the part government, especially at the federal level, is playing in meeting energy needs.

1. FEDERAL OFFICES AND AGENCIES (Energy):

DOE - Department of Energy
ERDA - Energy Research and Development Administration
EPA - Environmental Protection Agency
ERA - Economic Regulatory Administration
EIA - Energy Information Administration
Environmental Liaison Division
FERC - Federal Energy Regulatory Commission
FEA - Federal Energy Administration
NRC - National Regulatory Commission
OCS - Office of Conservation and Solar Applications
ORA - Office of Resource Application

2. MISCELLANEOUS:

OPEC - Organization of Petroleum Exporting Countries
TVA - Tennessee Valley Authority
TENNECO
TENNESSEE GAS PIPELINE
NASHVILLE GAS COMPANY
SOUTHEAST POWER SUPPLY
NASHVILLE ELECTRIC SERVICE
METRO WATER AND SEWERAGE DEPARTMENT

3. FEDERAL LEGISLATION/PROGRAMS:

National Energy Plan - 1977 (Carter Adm.)
Clean Air Act
Solid Waste Disposal Act - 1965
Resource Recovery Act - 1970
National Energy Act - 1978
National Energy Conservation Policy Act
Energy Tax Act - 1978
Natural Gas Policy Act - 1978
Public Utility Regulatory Policies Act
National Environmental Policy Act - 1969
Dept. of Energy Organizational Act
Materials Recovery Act - 1970
Resource Conservation and Recovery Act - 1976
Energy Security Act - 1980
Federal Ocean Dumping Act - 1974
Residential Energy Conservation Program

TVA Weatherization Program
NES Home Energy Audit (Nashville Elec. Service)
NGC Home Energy Audit (Nash. Gas Co.)

ANALYSIS OF THE PROPOSED NATIONAL ENERGY PLAN - August, 1977
Office of Technical Assessment (OTA)
Congress of the U.S.

**Purpose of energy conservation**

President Carter stated the problem of energy conservation clearly when he said, as paraphrased by *Changing Times*, that it was cheaper in the short run to save oil than to produce it, that production of oil and gas will keep pace with demand only if the government reduces demand, and finally, that increased production will in the end inevitably overwhelm the recoverable reserves.

In 1977, President Carter initiated a national comprehensive energy plan, aimed at the total flow of energy from the resources to conservation. He emphasized energy conservation as the cornerstone of the entire plan. More specifically, the plan had seven energy goals for 1985, with at least four of them suggesting a strong conservation program. The goals are:

1. Reduction of the annual growth rate in energy demand to less than two percent.
2. Reduction of gasoline consumption by ten percent.
3. A cut in foreign oil imports to six million barrels per day, less than half the level which would be reached without conservation efforts.
4. Establishment of petroleum reserves of one billion barrels, about a ten-month supply.
5. An increase in coal production of about 400 million tons annually, to more than one billion tons per year.
6. Insulation of 90 percent of American homes and all new buildings.
7. Use of solar energy in more than 2.5 million homes (U.S. Dept. of Health, Education and Welfare, p. 1).

Issue 5: State, County, and Local Government Transportation Fuel Conservation
Issue 6: The Role of Mass Transit in Transportation Energy Conservation
Issue 7: Transportation Regulation and Energy Conservation
Issue 8: Scope of Buildings Conservation Program
Issue 9: Materials Available for Building Conservation
Issue 10: Tax Credits for Energy Conservation in Buildings
Issue 11: Mandatory Standards for Major Appliances
Issue 12: Communication of Conservation Information

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ENERGY TECHNOLOGY: SOURCES OF POWER by Anthony Schwaller
Davis Publications, Inc.
Worcester, Massachusetts
Copyright 1980

See Chapter 12: Energy Conservation, pp. 368-412

35

# Federal Policy

## Background

Several Acts have established national policies and programs for technologies which reclaim materials and energy from MSW. Taken together, they demonstrate Congress' growing commitment to resource recovery, primarily as a supplemental source of materials and secondarily as an alternative source of energy. However, these Acts also demonstrate a continuing commitment to large-scale rather than to small-scale projects. Because systems appropriate for smaller communities may have problems not shared by large-scale systems, an analysis of current and upcoming legislation can help to identify those areas which may need to be addressed if these alternatives are promoted in the future.

The Solid Waste Disposal Act of 1965, a part of the Clean Air Act Amendments (Public Law 89-272, as amended), was the first major law prescribing the Federal role in resource recovery and reclamation from MSW. The Act recognized the contribution of solid waste disposal to air pollution abatement, and it encouraged the design and testing of solid waste management and resource recovery systems that would protect public health and the quality of the environment. To this end, it provided technical and financial assistance to State governments and interstate agencies in planning and developing programs for solid waste disposal and resource recovery. The Act also emphasized the need to improve management techniques and organizational arrangements for collecting, separating, recovering, and recycling solid wastes and for disposing of unrecoverable residues.

The stated purpose of the Resource Recovery Act of 1970 (Public Law 91-512), the second of the three major laws, was to amend the Solid Waste Disposal Act of 1965 "in order to provide financial assistance for the construction of solid waste disposal facilities." The Act not only stressed new methods of solid waste disposal, but also emphasized the importance of recycling and reuse of waste materials. In addition to monies allotted to conduct studies in several related areas, the Act made grants available for demonstration-scale resource recovery systems "of all types, and under representative geographical and environmental conditions." Further, its title II, the Materials Policy Act of 1970, established the National Commission on Materials Policy and required annual reports to the Congress on studies of various waste generation, materials recovery, and waste disposal options, practices, and policies. Under this Act the Administrator of EPA could fund resource recovery demonstration projects; award grants for State, interstate, and local planning; and recommend guidelines for solid waste recovery, collection, separation, and disposal systems.

The overall intent of these two laws, as expressed in the legislative findings of the 1970 Act, was to enhance the quality of the environment and conserve materials through the development of a national materials policy. Both emphasized that the primary responsibility for MSW collection and disposal rests at the local level.

## The Resource Conservation and Recovery Act of 1976

Between 1970 and 1976, when the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580) was passed, the issues of alternative energy sources, of materials recovery, and of technological size and complexity had become more important to Congress. RCRA reaffirmed that "the collection and disposal of solid waste should continue to be primarily a function of State, regional, and local agencies," but it also found that "the problems of waste disposal have become national in scope . . . and necessitate Federal action." While protecting public health and enhancing the quality of the environment remained a major function of the Act, it also sought to encourage the recovery of energy and materials from MSW.

RCRA's stated purpose was to "provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials." It established an Office of Solid Waste in EPA, through which all of the designated responsibilities except those pertaining to R&D were to be carried out (sec. 2007). Thus far, EPA has provided financial assistance to approximately 66 communities for feasibility analysis, development of a procurement strategy, and the solicitation and selection of contractors to design and construct facilities.

The Act also encouraged States and municipalities to take a more active role in the development of resource recovery projects. It called for the creation of "Resource Conservation and Recovery Panels," which were to "provide State and local governments upon request and without charge teams of technical, financial, marketing, and institutional specialists to render assistance on resource recovery and conservation" (sec. 2003). EPA, through its Technical Assistance Panels Program, provided staff and consultant expertise in these areas to over 160 communities during 1978 and 1979. EPA also provides States with funds to develop comprehensive plans for dealing with all areas of MSW management, and it has established planning requirements that require the removal of State laws that impede contracting for these projects. As a further aid, EPA has drafted a guide explaining how States can provide technical assistance, financial assistance, information dissemination, and other services to local communities.

Furthermore, in a notable expansion upon earlier legislation, RCRA required the Department of Commerce to promote the dissemination and commercialization of resource recovery technologies by providing: "1) accurate specifications for recovered materials; 2) stimulation of development of markets for recovered materials; 3) promotion of proven technologies; and 4) a forum for the exchange of technial and economic data relating to resource recovery facilities" (sec. 5001).

The Department of Energy (DOE), like EPA, also provides funds for feasibility studies by communities that are considering resource recovery projects. DOE also conducts and funds research into the basic science and technology underlying various processes for resource recovery.

Finally, beyond the provisions which promote recovery of energy and materials from solid wastes generally, RCRA contained several specific provisions which bear upon the technologies' appropriateness for local development. The first provided for information exchange among the several levels of government, and between government and private firms, regarding "technical and economic levels of performance that can be attained by various available resource recovery systems" (sec. 1008); this information on the range of available alternatives should aid local governments in choosing systems appropriate to their needs. Second, the Act required the EPA Administrator to "undertake a comprehensive study and analysis of systems of small-scale and low-technology waste management." (sec. 8002) Although the subsequent report has not received wide distribution, EPA's Office of Solid Waste has launched a Small-Scale and Low Technology Program designed explicitly to respond to the waste disposal needs of small communities. This program is likely to encourage the diffusion of small-scale technologies that are appropriate for local development.

There is, however, one provision in the Act which may mitigate against small-scale technologies: section 8006 authorizes Federal grants for the demonstration of resource recovery systems; but subsection 8006(c)(B)(2) requires that the share paid by a Federal grant for the construction of a project which serves only one municipality cannot exceed 50 percent, while if a project serves more than one municipality the grant can pay for 75 percent of construction costs. This provision may allow several municipalities to build larger facilities and to realize economies of scale, but it may also cause individual communities to lose control over the design, financing, and operation of their own resource recovery systems.

## Other Laws Having an Impact on Resource Recovery

**The Energy Security Act of 1980** (Public Law 96-294).—Title II of this Act contains several provisions dealing with "municipal waste biomass energy." It reconfirms the Federal Government's commitment to research, development, and demonstration of energy-from-waste technologies, but it also strengthens the existing mechanisms for promoting the adoption of these technologies. The Act broadens DOE's power to encourage the construction of municipal recovery projects by increasing the Federal share of construction loans to 80 percent and by allowing risk guarantees of up to 90 percent of principal and interest (sec. 233). The Act also allows DOE to make price support loans for existing projects and price guarantees for new projects (sec. 234). Finally, the Act established within DOE an Office of Energy from Municipal Waste to administer these programs.

**The Energy Tax Act of 1978** (Public Law 95-618).—This Act contains provisions that should influence resource recycling and recovery. The first provides an additional 10-percent investment tax credit (for a total of 20 percent) for the purchase of equipment used to recycle ferrous and nonferrous metals, textiles, paper, rubber, and other materials for energy conservation (sec. 301(c)(i)). The additional credit is available for a wide range of equipment placed in service after October 1, 1978. The second provision sets recycling targets for major energy-consuming industries, including the metals, paper, textile, and rubber industries. Specific targets will be set for the increased use of recycled commodities ~~over the~~ next 10 years.

**Amendments to Internal Revenue Code of 1954—Exempt Organizations** (Public Law 94-568).—Section 4 of this Act requires that "the Secretary of the Treasury, in cooperation with the Administrator of EPA, make a complete study and investigation of all provisions of the Internal Revenue Code of 1954 which discourage the recycling of solid waste material, and that he should report his findings to Congress, along with specific legislative proposals and detailed estimates of their costs." In compliance with this requirement, the Department of the Treasury published *Federal Tax Policies: Recycling of Solid Waste Materials* (February 1, 1979).

✓ **The Federal Ocean Dumping Act of 1974** (Public Law 92-532, as amended by Public Law 93-254).—While the general intent of the Act is the international protection of the oceans, one of its major effects has been virtually to eliminate the disposal of domestic solid wastes in the ocean. To the extent that it precludes the use of a former option for solid waste disposal, this Act increases the amount of solid wastes that communities must deal with.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: **IS YOUR SCHOOL WASTING HEAT?**

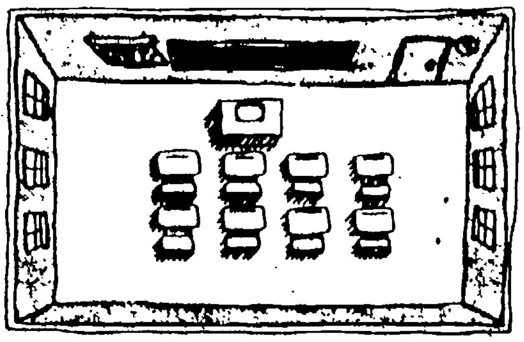
MATERIALS: 2 Thermometers.
Measuring tape

SUGGESTED PROCEDURE:

1. Measure and record the window and wall temperatures in your classroom.

2. Record your thermostat setting. How do the temperatures compare?

| Temperature comparison | | |
|---|---|---|
| window temperature | wall temperature | thermostat setting |
| | | |



3. Measure the total areas of the windows. Measure the total area of the floor.

| Window/Floor Ratio | | |
|---|---|---|
| area of windows | area of floor | window/floor ratio |
| | | |

4. Divide the floor measurement into the window measurement to get the window to floor ratio. A ratio greater than 10% is an energy waster.

5. Take a tour around your school. Make a list of energy conservation measures for your school. How can you implement your suggestions?

EXPECTED RESULTS: The student will be able to determine is heating energy is being wasted at school.

40

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 2 As much as 30-50% of the energy consumed in the U.S. is wasted.

ACTIVITY: THINKING ABOUT ENERGY CONSERVATION IN PERSONAL LIVES

MATERIALS: Copies of questions for each student. Pencil, paper.

SUGGESTED PROCEDURE:

1. Give each student a copy of the questions attached. Have them work individually on obtaining the correct answers.
2. Discuss each question with the class.
3. Let each student formulate a new energy conservation question.

EXPECTED RESULTS: Students will see a variety of ways in which energy savings can be made and the importance of conserving it wisely.

# CONSERVATION OF ENERGY QUESTIONS

1. Both the Smith Family and Wright Family homes contain 1500 sq. ft. of living space. Each family uses electricity in their homes. The Smith Family uses an average of 1250 kwh monthly while the Wright Family uses 1400 kwh normally. The Jones Family uses approximately 1600 kwh of electricity monthly for their home which contains 2000 sq. ft.

   The currect NBS rate is 4¢ per kwh of electricity used. Figure the average monthly bill for each family. Which family would seem to be less conservation conscious in their electricity usage?

   Think of several reasons why (generally) there could be noticeable differences in the electric bills among these and other similar homeowners.

2. Besides going to work or school, list several other instances when people might conserve energy/money on transportation through commuting, sharing, pooling, etc.

3. Two air conditionditioners are on sale at Sears. Brand X and Brand Y are both rated at 10,000 BTU/hr. Brand X costs $395 and operates on 1 kilowatt of electricity. Brand Y costs $195 and operates on 2 kilowatts. Electricity costs 4¢ per kilowatt hour. Which statement is true?
   A. Brand X will cool a room down faster.
   B. Brand Y will cool a room faster.
   C. Brand X is more efficient in its use of energy
   D. Brand Y is more efficient in its use of energy.
   E. Both X and Y cost the same amount to operate for an hour.

4. Assuming that both air conditioners are operated for an average of 1000 hours per year and have a lifetime of 10 years, which statement is true about the overall cost over the lifetime of the air conditioners?
   A. Brand X costs $200 more.
   B. Brand X costs $100 more
   C. They both cost the same.
   D. Brand Y costs $100 more.
   E. Brand Y costs $200 more.

**CONCEPT:** No. No. 2 As much as 30-50% of the energy consumed in the U. S. is wasted.

**ACTIVITY:** KILOWATTS AND ELECTRIC BILLS!

**MATERIALS:** Student copies of sheets (attached), pencil, paper. Electric bills from home, if available.

**SUGGESTED PROCEDURE:**

1. Have students do work sheets on kilowatts.
2. Have students do work sheets on meter reading.
3. Work on interpreting and verifying accuracy of personal electric bills.

**SAMPLE QUESTIONS:**

1. Reading date
2. No. of days in reading
3. Kilowatts used last yr. for same period
4. Present kilowatt reading
5. Gross, net cost
6. Calculate accuracy of fuel cost using current elec. rates.

NES "You Conserve Today. We Serve Tomorrow"
SAME MO LAST YR 1053KWH
ACCOUNT NUMBER 11115-022950-9 729 METER NO 153975
WRIGHT,JAMES E
1825 WELCOME LN SERVICE ADDRESS OF THIS METER
METER READING DATE
15616 05/22/81
14421 04/23/81
RESIDENTIAL 29 DAYS IN THIS PERIOD
1195 KWH USED 48.26
STATE SALES TAX .72
TOTAL GROSS BILL 51.39 DUE AFTER 06/11 TOTAL NET NOW DUE 48.98
KEEP THIS SECTION FOR YOUR RECORDS

NES "You Conserve Today We Serve Tomorrow"
SAME MO LAST YR 1480KWH
ACCOUNT NUMBER 11115-022950-9 529 METER NO 153975
WRIGHT,JAMES E
1825 WELCOME LN SERVICE ADDRESS OF THIS METER
METER READING DATE
17342 06/23/81
15616 05/22/81
RESIDENTIAL 32 DAYS IN THIS PERIOD
1726 KWH USED 70.33
STATE SALES TAX 1.05
TOTAL GROSS BILL 74.90 DUE AFTER 07/11 TOTAL NET NOW DUE 71.38
KEEP THIS SECTION FOR YOUR RECORDS

**EXPECTED RESULTS:** Students will learn meaning of kilowatt hours, how to read their electric meter, calculate energy use, savings, and determine accuracy of electric bill.

# RESIDENTIAL RATE--SCHEDULE RS-10
(Revision of April 2, 1981)

TO BE APPLIED TO ALL METER READINGS TAKEN ON AND AFTER APRIL 2, 1981

## Availability

This rate shall apply only to electric service to a single-family dwelling and its appurtenances where the major use of electricity is for domestic purposes such as lighting, household appliances, and the personal comfort and convenience of those residing therein. Any such dwelling in which space is occasionally used for the conduct of business by a person residing therein may be served under this rate. Where a portion of a dwelling is used regularly for the conduct of business, the electricity consumed in that portion so used shall be separately metered and billed under the General Power Rate; if separate circuits are not provided by the customer, service to the entire premises shall be billed under the General Power Rate.

## Character of Service

Alternating current, single-phase. 60 hertz. Voltage supplied shall be at the discretion of Distributor and shall be determined by the voltage available from distribution lines in the vicinity and/or other conditions. Multiphase service shall be supplied in accordance with Distributor's standard policy.

## Base Charges

Customer Charge:

$2.10 per delivery point per month

Energy Charge:

First 500 kilowatt-hours per month at 3.453 cents per kilowatt-hour
Additional kilowatt-hours per month at 4.157 cents per kilowatt-hour.

## Adjustment

The customer's bill for each month shall be increased or decreased in accordance with the current Adjustment Addendum published by TVA.

## Minimum Monthly Bill

The customer charge constitutes the minimum monthly bill for all customers served under this rate schedule except those customers for which a higher minimum monthly bill is required under Distributor's standard policy because of special circumstances affecting Distributor's cost of rendering service.

## Payment

Bills under this rate schedule will be rendered monthly. Any amount of bill unpaid after due date specified on bill may be subject to additional charges under Distributor's standard policy.

## Single-Point Delivery

The charges under this rate schedule are based upon the supply of service through a single delivery and metering point, and at a single voltage. If service is supplied to the same customer through more than one point of delivery or at different voltages, the supply of service at each delivery and metering point and at each different voltage shall be separately metered and billed under this rate schedule.

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Service is subject to Rules and Regulations of Distributor.

NASHVILLE ELECTRIC SERVICE
RESIDENTIAL ENERGY DEPT.
(615) 747-3559

44

WHAT IS A KILOWATT-HOUR ?

Take a look at an ordinary light bulb and you will notice that its wattage is indicated. For example, the bulb might read 100 watts, 60 watts, 40 watts, and so on. The wattage marked on a bulb indicates the amount of electricity that bulb will use in one hour.

For example, a 100-watt bulb will use 100 watt-hours of electricity in 1 hour. Similarly, a 60-watt bulb will use 60 watt-hours of electricity in 1 hour. How many watt-hours electricity will a 40-watt bulb use in one hour ?

__________ watt-hours.

******************************************************

Will a 15-watt bulb use 30 watt-hours of electricity in 1 hour ? ____

Since a 40-watt bulb will use ________ watt-hours of electricity in 1 hour, then the same bulb will use ______ watt-hours of electricity in 2 hours. How many watt-hours of electricity will a 40-watt bulb use in four hours ? __________

To answer this question, you must multiply the number ______ by the number ________. You find that a 40-watt bulb will use 160 watt-hours of electricity in four hours.

******************************************************

Answer the following:

1. A 100-watt bulb will use 100 ______________ of electricity in 1 hour.

2. Two 100-watt bulbs will use ____________________ of electricity in 1 hour.

3. How many watt-hours of electricity will 3 60-watt bulbs use in 1 hour ? in three hours ?



The average family will use many 100-watt bulbs, many other bulbs of varying wattage, and a number of electrical appliances as well. It is for this reason that the typical home will probably use during one month several thousand watt-hours of electricity.

Because the average home will use several thousand watt-hours of electricity in one mont, it is more convenient to measure the amount of electricity in a unit larger than the watt-hour. One kilowatt-hour is equal to 1000 watt-hours. REMEMBER that a kilowatt-hour is larger than a watt-hour.

Two kilowatt-hours equal __________ watt-hours.

500 watt-hours equal _________ of a kilowatt-hour.

How many watt-hours equal 5 kilowatt-hours. ____________

<u>If five 200-watt bulbs were used for one hour, they would use a total of 5 times 200 watt-hours or 1000 watt-hours or 1 kilowatt-hour.</u>

******************************************************

ANSWER THE FOLLOWING:

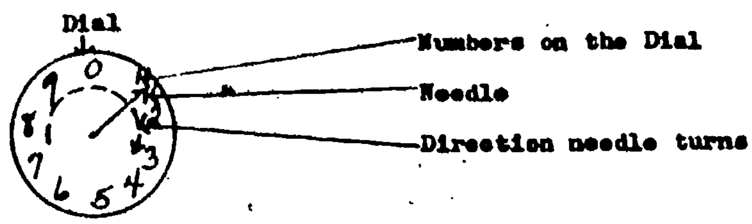
1. If each fluorescent tube in the lighting fixtures in your classroom is labeled 40 watts, how many watt-hours of electricity is being used in 1 hour ? How many kilowatt-hours in I hour ?

2. How many kilowatt-hours is being used today if the lights in this classroom are turned on for 8 hours ?

3. In what other ways besides the overhead lighting is electricity used in the classroom ?

LEARNING ACTIVITY ON METER READING

The amount of electricity you use is measured by a METER attached to your house or apartment. An electricity meter has dials on which one or more needles will point to the number of kilowatt-hours of electricity that you have used since the meter was installed. One of the dials on the meter will look like this:



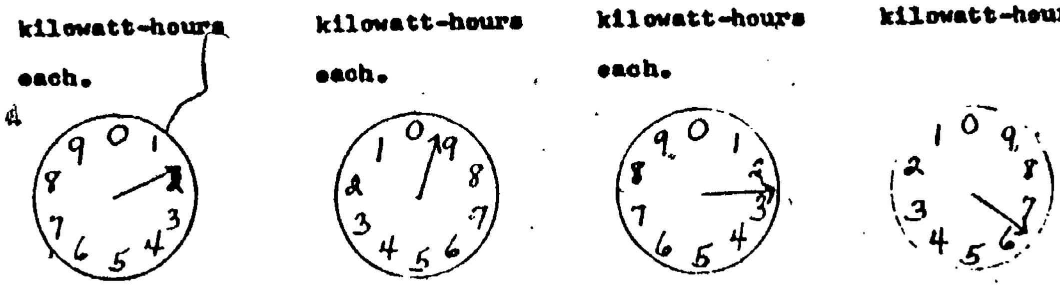

STUDY THE ILLUSTRATION BELOW.

This Dial counts units of 1000 kilowatt-hours each.

This Dial counts units of 100 kilowatt-hours each.

This Dial counts units of 10 kilowatt-hours each.

This Dial counts single kilowatt-hours.



Dial A Dial B Dial C Dial D

Dial A. The needle turns in a clockwise direction.

Dial B. The needle turns in a counterclockwise direction.

Dial C. The needle turns in a clockwise direction.

Dial D. The needle turns in a counterclockwise direction.

As the needle turns in a clockwise or counterclockwise direction, it counts one unit of electricity used. The number of units counted is THE LAST NUMBER PASSED BY THE NEEDLE.

The diagram on the preceding page of the single dial shows that one unit of electricity has been counted.

STUDY THE second illustration carefully to notice that several dials are needed to count the total number of units of electricity used in a home. The reason for the four dials is that each dial can count only ten units, so each dial as explained will count a unit of a different size.

Notice that the needle on Dial A has just passed the number 1. Therefore, this needle has just counted one unit that measures ________(1, 10, 1000) kilowatt-hours. Dial A measures_________ kilowatt-hours.

The needle on Dial B has just counted the number 9. This needle has just counted 9 units, each measuring________(9, 100, 900) kilowatt-hours. Dial B reads_____________(9, 100, 900) kilowatt-hours.

The needle on Dial C has just counted the number 2. Dial C reads_________(2, 10, 20) kilowatt-hours.

The needle on Dial D has just counted the number 6. Dial D reads________(6, 60, 1) kilowatt-hours.

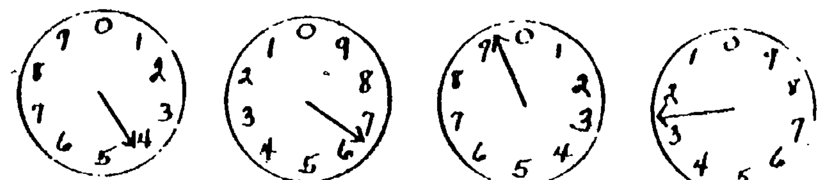
The correct choices for the blanks above are 1000, 1000, 100 900, 20, 6.

In order to get the total reading of the electricity meter shown above, we must add together the readings on Dials A, B, C, and D. In other words, we must add 1000, 900, 20, and 6 to get a total of 1926 kilowatt-hours.



Study the meter below. Fill in the blanks beneath each dial.

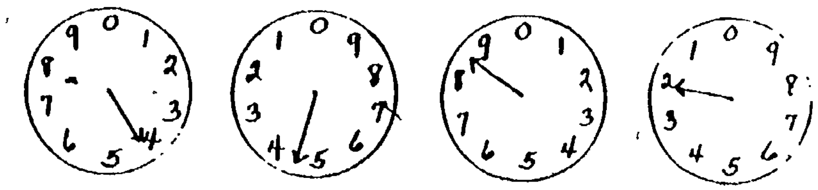
| 1000 | 100 | 10 | 1 |
|---|---|---|---|



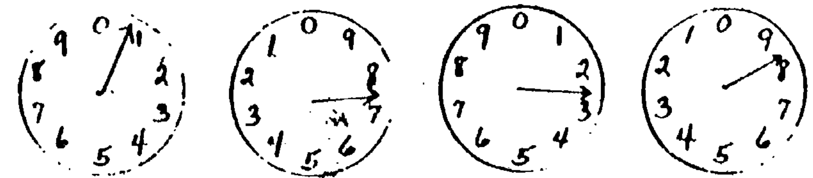
| means______ kilowatt-hours | means______ kilowatt-hours | means______ kilowatt-hours | means______ kilowatt-hours |
|---|---|---|---|

According to your calculations, this meter shows that a total of___________kilowatt-hours have been used.

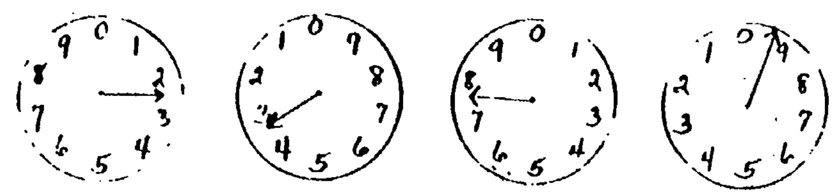
The meter shown below reads___________kilowatt-hours.



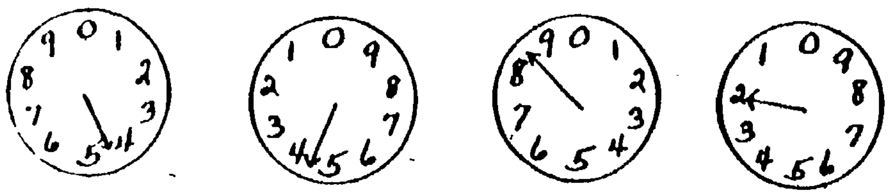
This meter reads___________kilowatt-hours.



This meter reads__________kilowatt-hours.

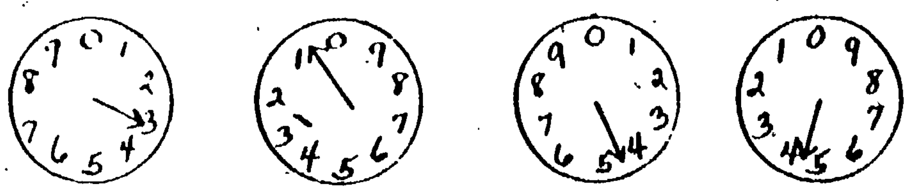


Each month a man from the power company is sent to your home to read your electricity meter. His job is to determine how much electricity you used during the month. For example, suppose your meter looked like this in the month of April:



According to the meter, you have used to date __________ kilowatt-hours of electricity.

In May, the person from the power company makes another reading.



He finds that your electricity meter now reads__________ kilowatt-hours. Since the April reading, you have used__________ kilowatt-hours. You find this by subtracting the April reading from the May reading.

YOU SHOULD NOW BE ABLE TO FIND AND READ THE METER FOR ELECTRICITY IN YOUR OWN HOME.



DAILY USE OF ELECTRICITY IN MY HOME

| DATE | TIME | ELECTRIC METER READING (kwh) | KILOWATT-HOURS USED DAILY | $ |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |
| 11. | | | | |
| 12. | | | | |
| 13. | | | | |
| 14. | | | | |

48

ELECTRICITY RATE SCHEDULE FOR GREEN BAY (May, 1975)

ENERGY CHARGE

| | |
|---|---|
| First 200 Kwh at | $ .0430 |
| Next 1300 Kwh at | .0260 |
| Over 1500 Kwh at | .0215 |
| Total Kwh at (Fuel Clause) | .00215 |

SAMPLE BILL COMPUTATION: Suppose that your total electricity consumption for the month amounted to 500 Kwh. The charge for this monthly consumption would be figured out in this way.

First 200 Kwh at $.0430........$8.60
Next 300 Kwh at $.0260.........$7.80
Total of 500 Kwh at $.00215....$1.08 (Fuel Clause)
Total..$17.48

WORK SPACE FOR ABOVE COMPUTATIONS:

200
x.0430
6000
800
8.6000

300
x.0260
18000
600
7.8000

.00215
x 500
1.07500 ≐ 1.08

$ 8.60
7.80
+ 1.08
$ 17.48



COMPUTING ELECTRIC BILLS

Work all problems on this paper showing the calculations for each. Use the Green Bay rate schedule to do these.

1. Mr. Collins read his meter at the beginning of May It read 4335 Kwh. When he subtracted the April reading of 3916, he found the number of kilowatt-hours he used in one month. What would his electric bill amount to in Green Bay ?

2. Can you find an error in this bill ?

Mr. J. J. Jones
111 Energy Blvd.
Antsville, Indiana 60761

| Previous meter reading | Present meter reading | No. Kwh. Used | Amount to be paid |
|---|---|---|---|
| 3569 | 4129 | 560 | $20.16 |

3. The Wisconsin Public Service Corporation decided to drop its fuel charge for the next three months. How would this reduce the electricity bill in problem 1.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: WHAT'S YOUR E.Q.?
ANNUAL/MONTHLY ELECTRICAL ENERGY USE & COST DATA

MATERIALS: Student copies of E.Q. Quiz

SUGGESTED PROCEDURE:

This quiz may be used as a pre-test or a post-test on energy conservation around the home.

Students may use the Annual/Monthly Electric Energy Use & Cost data on the back of the quiz in a number of ways.

Suggestions:

Have each student check the appliances on the list if found in their individual homes. Have them calculate sub-totals of such appliances at current electric rate - 4¢ N.E.S. and figure total cost. ( Notice chart is based on 1500 sq. ft. home.) Then have students compare an actual electric bill from their homes with their calculations.

EXPECTED RESULTS:

Students will learn various ways of becoming more energy efficient at home.

Students will have a means of comparison in determining individual home use of electricity.

Lint Zephyr

2. Lint Zephyr

50%

3. 50 percent

4. Pots & Pans

5. Insulation

more

6. More

Wasteful

7. Wasteful

8. 78 degrees

50

# what's your E.Q.?

**How much do you know about energy? What's your Energy Quotient? To find out, read each statement. Find its correct answer. Then write the number of the answer in the box following the statement.**

A. Slows the movement of heat. [ ]

B. Recommended home temperature in winter. [ ]

C. Open and close it quickly. [ ]

D. A quick shower uses ______ the water of a normal bath. [ ]

E. Put it around windows and doors. [ ]

F. Maximum temperature for water heater. [ ]

G. Insulated drapes can block out ______ of the heat from the sun. [ ]

H. Look for it on an air conditioner. [ ]

I. What every cooking pan needs on top. [ ]

J. Heat Pump. [ ]

K. Using the range oven for a heater or toaster is a ______ use of energy. [ ]

L. Should be flat-bottomed. [ ]

M. Air condition at ______. [ ]

N. Clean it after each dryer load. [ ]

O. Solid-state appliances use ______ energy than tube types. [ ]

P. Vent it to the outside. [ ]

Q. Heating and cooling system ______ should be cleaned or replaced every 30 days. [ ]

R. Fluorescent lights are at least ______ times more efficent than incandescent lights. [ ]

S. Clothes washers and dishwashers are most efficient when washing ______ loads. [ ]

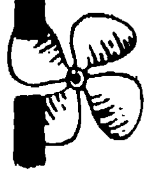
T. Small appliances are ______ users of energy. [ ]

1/3

One-third

Half

9. Half



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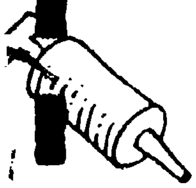


7. Caulk

LESS

Less

78 degrees or higher

25. 78 degrees or higher

effi-cient.

4. Efficient

Refrigerator door

3. Refrigerator door

3½

9. 3½

66°

10. 66

11. 68 degrees

EER

12. A high EER

Plas-tic

13. Plastic

14. 1/32 inch

A tight-fitting lid

15. A tight-fitting lid

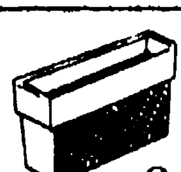
200 percent heating efficiency

16. 200 percent heating efficiency

Use Electricity Wisely

Full

filters



150 degrees

170 degrees

TVA

POWER UTILIZATION DIVISION

# Driving Tips To Help You Save Gas



If you have a larger ("mid-size") car, you might be surprised how much gasoline money can be saved by some simple conserving actions. In one of its "answer" booklets, Shell Oil recently compiled the savings that such a car (12.5 mpg city, 17.7 mpg highway) could accumulate over a 10,000-mile year's worth of driving (60% city, 40% highway) if any one of a number of tips were followed. The money savings are given at the end of this article.

TEA recognizes that much greater savings are possible if one swaps in the gas guzzler for a small car. The car in the Shell Oil example would have to buy gas frequently, at a price of at least $1.40 per gallon, for a yearly total of $985.60. A small car getting mileage of 25 mpg city and 35 mpg highway would spend $496.01. This savings is greater than almost any of the "tips" chart, and the small car also maintains the flexibility of personal transportation. (There is, however, the problem of safety. For tips on combating special small car hazards, write the Governor's Highway Safety Program, Suite 1800, James K. Polk State Office Building, Nashville, TN 37219, for a booklet, "Small Car Driving: A New Experience.") For the precise savings in a comparison of all auto brands, the DOE/EPA "1981 Gas Mileage Guide" is available throug the TEA ENERGY HOTLINE, 1-800-342-1340.

The big car savings for each auto efficiency tip are as follows:

| IF YOU: | YOU CAN SAVE: |
|---|---|
| • Pool with three friends, 40 miles round trip. (*1,2) | $ 728 per year; 43.3 gallons per month<br>$ 60.67 per month (*3) |
| • Use public transportation to commute 30 miles round trip (*1,2) | $ 364 per year; 44.0 gallons per month<br>$ 30.33 per month |
| • Downsize to a 1981 compact from your 1977 mid-size and obtain 50% better mileage | $ 329 per year; 19.6 gallons per month<br>$ 27.42 per month |
| • Pool with a friend, 10 miles each way (*2) | $ 242 per year; 14.4 gallons per month<br>$ 20.00 per month |
| • Reduce one five mile errand daily for six days | $ 217 per year; 12.7 gallons per month<br>$ 17.72 per month |
| • Keeping your new set of radials properly inflated, reduce one errand daily | $ 177 per year; 10.6 gallons per month<br>$ 14.79 per month |
| • Reduce one errand daily for six days, two miles round trip | $ 107 per year; 6.3 gallons per month<br>$ 8.89 per month |
| • Next car trade, buy a 4-cylinder engine model instead of a 6 or 8 | $ 67 per year; 4.0 gallons per month<br>$ 5.55 per month |
| • Drive at 55 mph | $ 60 per year; 3.6 gallons per month<br>$ 5.04 per month |
| • Install radials when replacing tires | $ 50 per year; 3.5 gallons per month<br>$ 4.93 per month |
| • Cut off air conditioning (*4) | $ 25 per year (4 warmest months) |

*NOTES: (1) Fare of $1.50 a day is subtracted from these figures.
(2) Some additional savings in parking would occur.
(3) Longer radial tire life totally offsets higher price.
(4) TEA staff computation based on a study done by the city of Baltimore.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

**CONCEPT:** No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

**ACTIVITY:** ELECTRICAL APPLIANCES

**MATERIALS:** Student copies of chart and questions.

**SUGGESTED PROCEDURE:**

1. Give each student a copy of the chart. Have them decide which of the appliances are found in their homes. (Which ones are found at school?)

2. Discuss why some appliances use more kilowatts than others. Explain EER to students.

3. Figure annual costs at 4¢ per kwh; divide by 12 for average monthly cost (for those appliances found in respective homes).

4. Pretend there is a national emergency and home energy must be reduced. Each dwelling must submit a list of electrical appliances which, when removed from the home, will reduce home consumption by 25%. What will each family give up

**EXPECTED RESULTS:** Students will learn more about kilowatt usage in electricity, efficiency ratings of appliances, non-essentials in home appliances.

## Major Electrical Uses in Residential Buildings

| | Kilowatt-hour/Year |
|---|---|
| Quick Recovery Water Heater | 4,811 |
| Refrigerator/Freezer | |
| Manual Defrost (10–15 cubic feet) | 700 |
| Automatic Defrost (16–18 cubic feet) | 1,795 |
| Automatic Defrost (20 cubic feet & up) | 1,895 |
| Freezer (15–21 cubic feet) | |
| Chest Type, Manual Defrost | 1,320 |
| Upright Type, Manual Defrost | 1,320 |
| Upright Type, Automatic Defrost | 1,985 |
| Range | |
| With Oven | 1,175 |
| With Self-cleaning Oven | 1,205 |
| Clothes Dryer | 993 |
| Room Air Conditioner (Based on 800 hours of operation per year. This figure will vary widely depending on area and specific size of unit.) | 688 |
| Central Air Conditioning | 4,800 |
| Electric Resistance Heating | 21,000 |
| Heat Pump | 14,000 |
| Home Entertainment | |
| Radio | 86 |
| Radio/Record Player | 109 |
| Television | |
| Black and White (solid state) | 100 |
| Black and White (tube type) | 220 |
| Color (solid state) | 320 |
| Color (tube type) | 528 |
| Comfort Conditioning | |
| Air Cleaner | 216 |
| Attic Fan | 291 |
| Dehumidifier | 377 |
| Humidifier | 163 |
| Rollaway Fan | 138 |
| Window Fan | 170 |
| Laundry | |
| Automatic Washing Machine | 103 |
| Iron (hand) | 60 |
| Food Preparation | |
| Blender | 1 |
| Broiler | 85 |
| Carving Knife | 8 |
| Coffee Maker | 106 |
| Deep Fryer | 83 |
| Dishwasher | 363 |
| Mixer | 2 |
| Microwave Oven | 190 |
| Roaster | 60 |
| Trash Compactor | 50 |
| Waffle Iron | 20 |
| Miscellaneous | |
| Clock | 17 |
| Hair Dryer | 14 |
| Heating Pad | 10 |
| Sewing Machine | 11 |
| Shaver | 0.5 |
| Sun Lamp | 0.5 |
| Tooth Brush | 1 |
| Vacuum Cleaner | 46 |

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY:

# COOKING WITHOUT HEAT

MATERIALS: Ordinary wooden box with wooden lid or board to place on top. Large enough to hold a two-quart kettle, leaving at least six inches on sides, bottom, and top to stuff insulating material. Insulation: hay, cork, pine needles, sawdust, or wadded newspaper.

SUGGESTED PROCEDURE: Pack box well with insulation material, molding a little nest in the middle for the pot.

Choose recipes in which the ingredients are covered with liquid and boiled on top of the stove first. Most soups, stews, and some puddings work.

The denser the pot, the better the heat retention. Iron and stoneware work best Receptacle and ingredients must be piping hot. Tightly seal with a lid at once, place in the insulated "nest," cover immediately with more hay, and top with an insulating pad (pillow or blanket is good). Fasten lid shut or weight down the board, covering hay box to that it is as airtight as possible. Meats generally need 8 box hours, vegetables 4-6 hours. The cooked food will be lukewarm when removed from box. Boil contents on top of stove 3-5 minutes to bring to serving temperature, plus kill any bacteria that might have developed. Be sure not to remove cover during cooking time while food is in the box!

(See attached recipes.)

EXPECTED RESULTS: Students can experience an effective means of heat conservation in cooking by trying this natural method used during World War I when fuel was scarce.

Many recipes may be adapted for the hay box, including those from Crock-Pot

The following recipe for short-rib vegetable soup is adapted from *Soup and Bread; 100 Recipes for Bowl and Board* by Julia Older and Steve Sherman (The Stephen Greene Press, 1978).

**Short-Rib Vegetable Soup**

- ½ cup diced onion
- 1 tablespoon minced fresh celery leaves
- ¾ cup diced potato
- ¾ cup diced carrot
- ¾ cup diced celery
- 1 cup chopped cabbage
- 1 cup fresh whole peeled tomatoes
- 2 pounds short ribs, cut into 3-inch pieces
- 5 cups water
- 1 bay leaf
- salt and freshly ground black pepper to taste
- ¼ cup barley

Assemble and prepare all vegetables. Place short ribs and water in a heavy soup pot. Turn burner to high and boil. Add all the vegetables and bring to a rolling boil. Add bay leaf, salt and pepper, and barley. Stir well. Cover immediately with a tight-fitting lid. Cook in a hay box 8 hours. Reheat on top of stove a few minutes and serve. Serves 6 to 8.

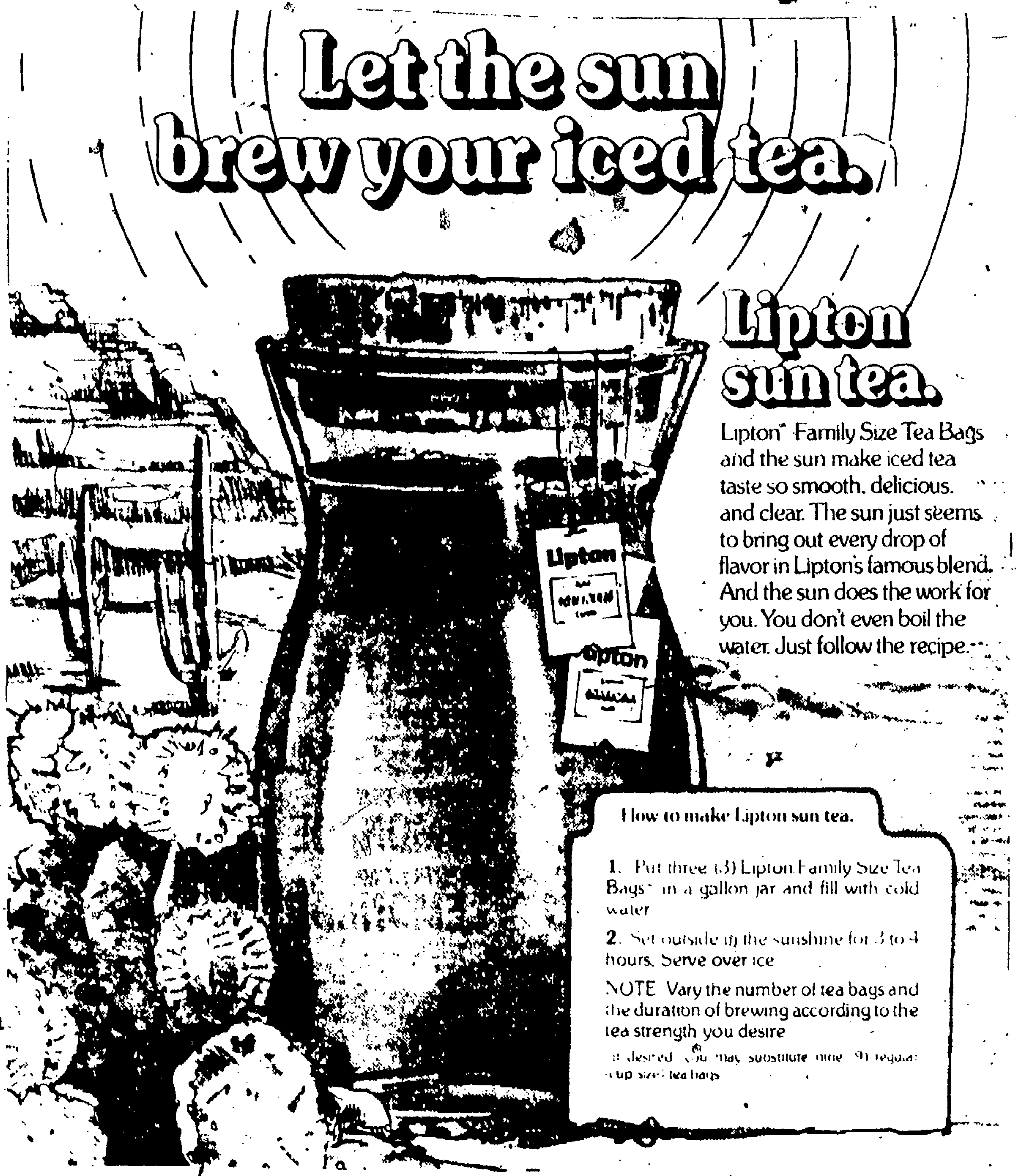
**Baked Beans**

- 1 pound white pea beans soaked in water to cover overnight
- ¼ cup brown sugar
- ½ cup blackstrap molasses
- ½ cup ketchup or chili sauce (optional)
- 2 teaspoons dry mustard
- 1 teaspoon vinegar
- 2 teaspoons salt
- ¼ teaspoon black pepper
- ⅛ teaspoon ginger
- ½ cup water
- 2 rashers of lean bacon, diced
- ¼ pound salt pork scalded with boiling water
- extra boiling water

Place beans in a large kettle with water to cover. Cook at a fast boil 40-60 minutes. (Beans should be edible but firm.) In a separate small pan combine brown sugar, molasses, ketchup, mustard, vinegar, seasonings, and water. Bring these ingredients to a boil. Fill a 2-2½ quart bean pot with boiling water. Put on the lid and let stand until ready to use.

Drain beans, reserving the cooking liquid in pan over high heat. Mix bacon into beans. Empty water from bean pot. Place salt pork on the bottom of the pot and cover with beans. Pour the boiling hot molasses mixture and bean liquid over the beans. If these do not cover the beans, add boiling water until beans are just covered.

Seal with lid at once and wrap pot in a towel. Place bean pot in hay box immediately and leave for 8 hours. Beans may be reheated in a kettle and returned to the bean pot for serving or storing. Serves 6 to 8.


Let the sun brew your iced tea.
Lipton sun tea.
Lipton® Family Size Tea Bags and the sun make iced tea taste so smooth, delicious, and clear. The sun just seems to bring out every drop of flavor in Lipton's famous blend. And the sun does the work for you. You don't even boil the water. Just follow the recipe.
Lipton
Lipton
How to make Lipton sun tea.
1. Put three (3) Lipton Family Size Tea Bags* in a gallon jar and fill with cold water
2. Set outside in the sunshine for 3 to 4 hours. Serve over ice
NOTE Vary the number of tea bags and the duration of brewing according to the tea strength you desire

CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY:

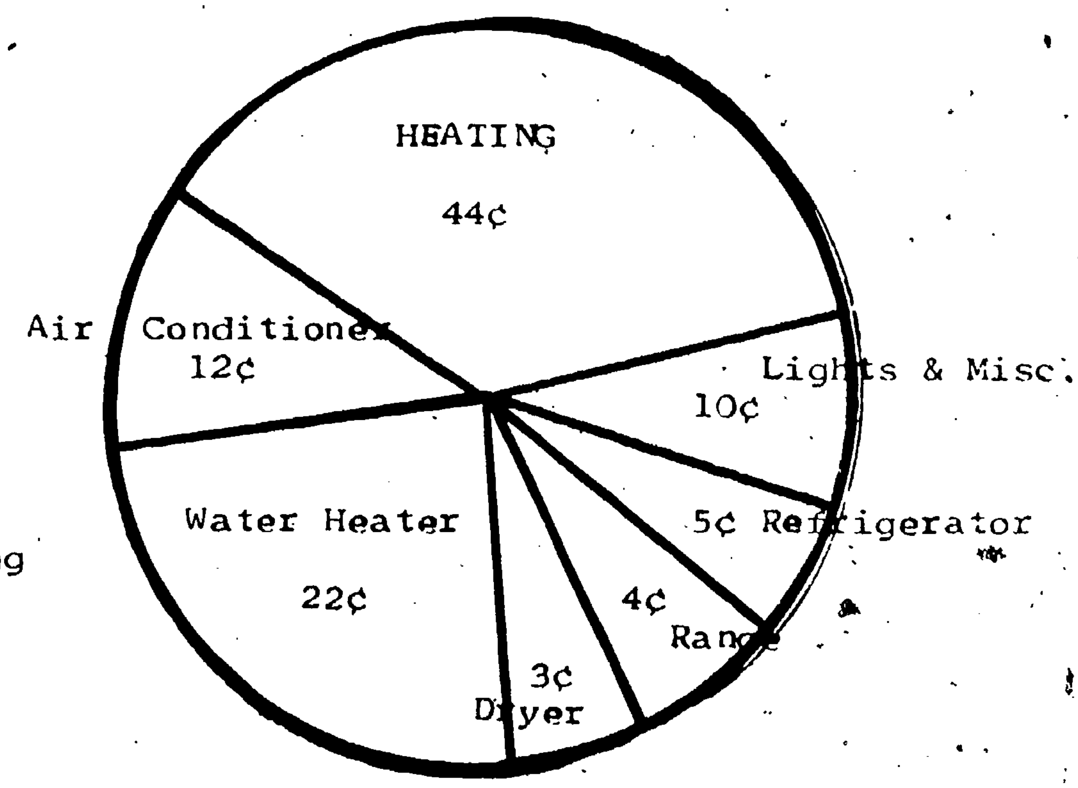
HOW YOU SPEND YOUR ENERGY DOLLAR!

MATERIALS: Copies of pie graph for each student. One copy should have unfilled blanks. Second copy should give correct infor.

SUGGESTED PROCEDURE:

1. Have students fill in blanks on each section of the pie chart without prior research. Major categories might be print on chalkboard first.

2. Give correct copy to students. Have them discuss each section. Or students may do research for correct answers before being given correct information.




EXPECTED RESULTS:

Students will become more aware of the major costs of electricity usage in their homes and its distribution.

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

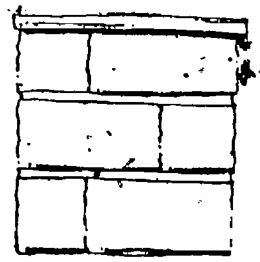
A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: **MAKE A CONTAINER THAT WILL KEEP AN ICE CUBE FROM MELTING**

MATERIALS:

Uniformly sized ice cubes
Small plastic bags
Assortment of materials to make ice cube boxes
(foil, styrofoam cups, styrofoam chips, tin cans, plastic cups, fiberglass, foam, newspaper, fabric scraps, etc.)
Various types of insulating materials
(Bricks might work — what will you use?)
Metric measuring cup

SUGGESTED PROCEDURE:



Build a container large enough to hold one ice cube in a plastic bag.

After 1 hour or longer, open the containers. Measure the water in the bags.

EXPECTED RESULTS:

Students will be able to determine what types of materials were the best insulators.

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

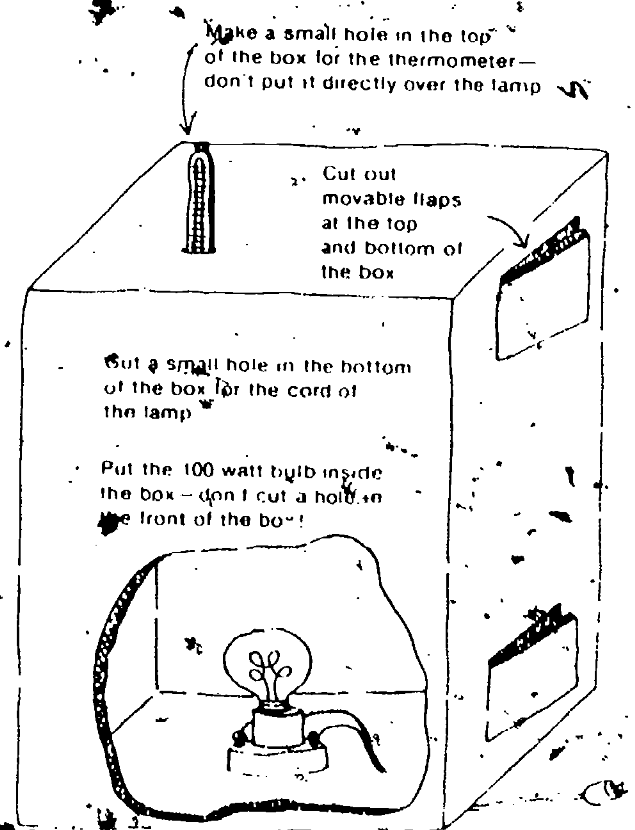
A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: **HOW HIGH WILL THE TEMPERATURE RISE IN A CLOSED BOX WHICH IS HEATED FOR 5 MINUTES**

MATERIALS:

Tall cardboard box
100 Watt bulb in ceramic socket
Thermometer
Knife; watch
Pencil; tape
Plastic food wrap

SUGGESTED PROCEDURE:




Record the temperature readings with the flaps open and closed.

Compare the results.

| | Temperature °C | | | | | |
|---|---|---|---|---|---|---|
| | Start | 1 min | 2 min | 3 min | 4 min | 5 min |
| Both flaps closed | | | | | | |
| Top open, bottom closed | | | | | | |
| Bottom open, top closed | | | | | | |
| Both flaps open | | | | | | |

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: USING THERMOGRAMS!

MATERIALS: Copies of several different thermograms for group or individual student use. Pencil, paper.

SUGGESTED PROCEDURE:

Explain how thermograms aretaken and used by various groups.

Have students study individual thermograms and develop theories for the heat losses indicated.

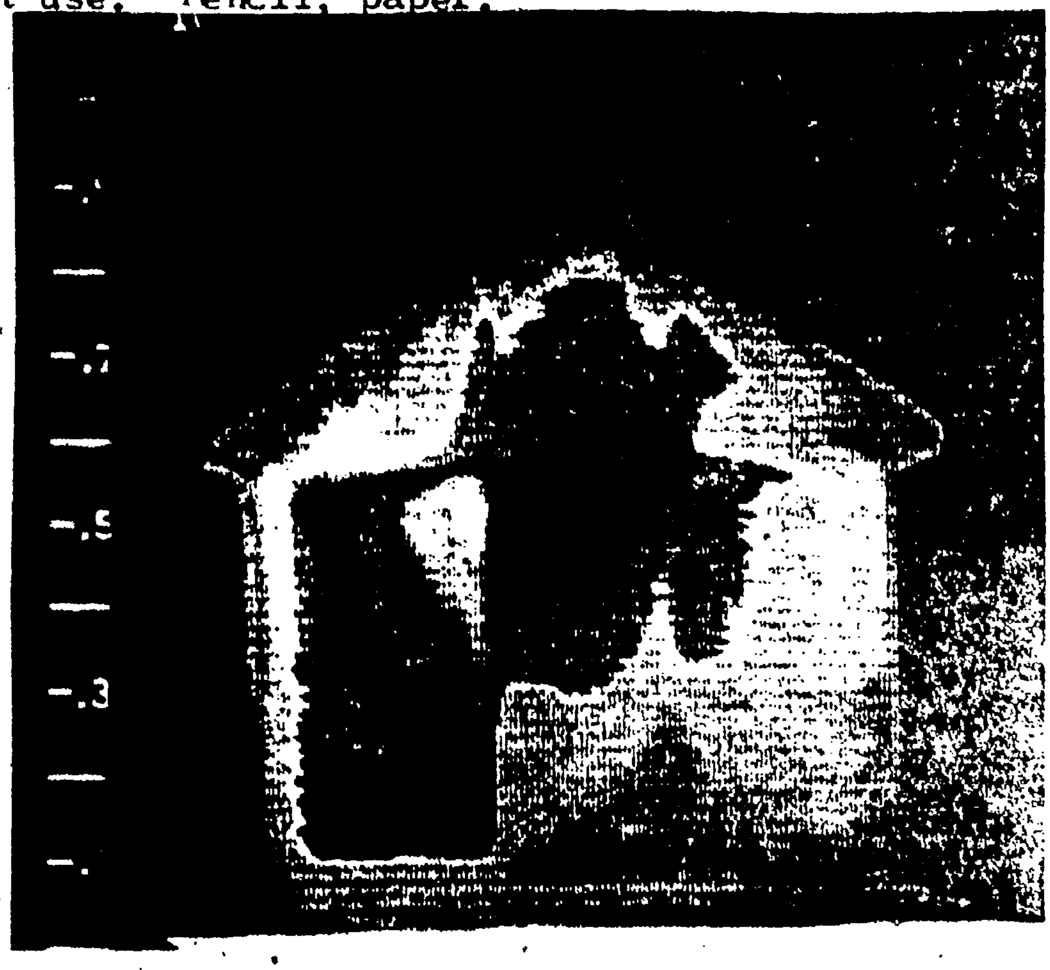



**Figure 12.6. A thermogram display of a building shows areas of infrared heat losses. The places where heat is being lost shows up lighter (courtesy, Energy Conservation Consultants).**

EXPECTED RESULTS:

Students will understand the purposes of thermograms and how they may be used to help conserve energy in a variety of places.

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: INSULATION AND R-VALUES!

MATERIALS:

A. Student copies of attached charts, data sheets Pencil, paper.

B. Examples of various kinds of insulating materials for ceilings, walls, floor of homes. Pencil, paper, calculators.

SUGGESTED PROCEDURE:

Part A:

Have student use a political/physical atlas or U.S. map to locate the cities indicated.

Have them determine which climate zone each is located in. Using the map legend (zone map), have them list the R-values for recommended insulation for ceilings, walls, floors beside each city.

Have them answer questions on attached sheet.

Discuss geographical, climatic influences with class.

Part B:

Let students examine insulation materials. Discuss R-values. Give theoratical problems concerning ciling insulation in various zones and costs.

EXPECTED RESULTS:

Students will have understanding of geographical influences on climatic conditions in U.S. Students will learn about various types of home insulation, R-values, and increase knowledge of insulation costs and types needed according to climatic zones.

 62

## Table 12.8 Thermostat Setback Savings by Percentage

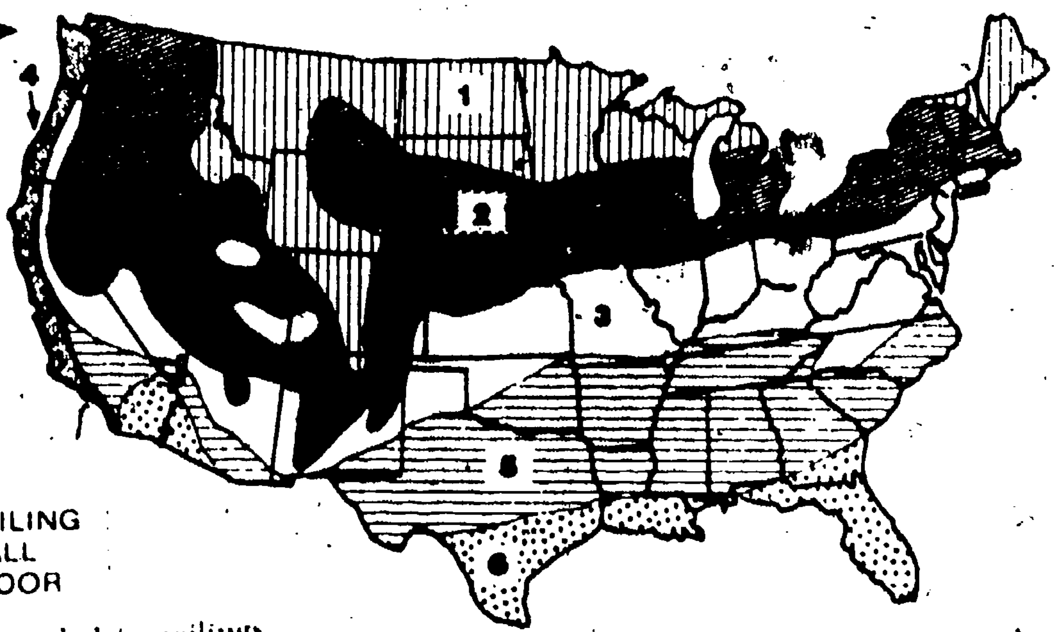
| City | 3°C (5°F) | 6°C (10°F) |
|---|---|---|
| Atlanta, GA | 11 | 15 |
| Boston, MA | 7 | 11 |
| Buffalo, NY | 6 | 10 |
| Chicago, IL | 7 | 11 |
| Cincinnati, OH | 8 | 12 |
| Cleveland, OH | 8 | 12 |
| Columbus, OH | 7 | 11 |
| Dallas, TX | 11 | 15 |
| Denver, CO | 7 | 11 |
| Des Moines, IA | 7 | 11 |
| Detroit, MI | 7 | 11 |
| Kansas City, MO | 8 | 12 |
| Los Angeles, CA | 12 | 16 |
| Louisville, KY | 9 | 13 |
| Madison, WI | 5 | 9 |
| Miami, FL | 12 | 18 |
| Milwaukee, WI | 6 | 10 |
| Minneapolis, MN | 5 | 9 |
| New York, NY | 8 | 12 |
| Omaha, NE | 7 | 11 |
| Philadelphia, PA | 8 | 12 |
| Pittsburgh, PA | 7 | 11 |
| Portland, OR | 9 | 13 |
| Salt Lake City, UT | 7 | 11 |
| San Francisco, CA | 10 | 14 |
| Seattle, WA | 8 | 12 |
| St. Louis, MO | 8 | 12 |
| Syracuse, NY | 7 | 11 |
| Washington, DC | 9 | 13 |

*Note.* Setting back the thermostat 6°C (10°F) each night for eight hours will save 16% of the heating bills in Los Angeles, California.

| ZONE | CEIL. | WALL | FLOOR |
|---|---|---|---|

1. Look at a physical atlas. What geographical features seem to influence the climatic divisions indicated on the map. →
2. What does latitude have to do with climatic conditions?
3. What types of heating/cooling are more economically feasible for the various zones?

**INSULATION R—VALUES FOR VARIOUS GEOGRAPHICAL LOCATIONS**




| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| CEILING | 38 | 33 | 30 | 19 | 26 | 26 |
| WALL | 19 | 19 | 19 | 11 | 19 | 13 |
| FLOOR | 22 | 22 | 19 | 11 | 13 | 11 |

Figure 12.1. A geographical summary of the R-values needed in ceilings, walls, and floors. Note: These insulation values are for homes heated with natural gas. Other forms of heating are generally higher (adapted from FMC Corporation, p. 9).

PART B:

## Table 12.4 Cost vs. R-value Balance

| Heating Cost: Gas-Natural/ Therm | Oil/ gallon | Electric Resistance/ kilowatt-hour | Electric Heat Pump/ kilowatt-hour | Recommended Insulation (ceiling) R-value, Zone 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|
| $ .09 | $ .13 | $ — | $ .01 | R-19 | R-19 | R-19 | R-19 | R-19 | R-19 |
| .12 | .17 | — | .013 | R-19 | R-19 | R-19 | R-19 | R-19 | R-30 |
| .15 | .21 | — | .017 | R-19 | R-19 | R-19 | R-19 | R-30 | R-30 |
| .18 | .25 | .01 | .02 | R-19 | R-19 | R-19 | R-19 | R-30 | R-30 |
| .24 | .34 | .013 | .026 | R-19 | R-19 | R-19 | R-30 | R-33 | R-38 |
| .30 | .42 | .016 | .033 | R-19 | R-19 | R-30 | R-30 | R-33 | R-38 |
| .36 | .50 | .02 | .04 | R-19 | R-30 | R-30 | R-33 | R-38 | R-44 |
| .54 | .75 | .03 | .06 | R-19 | R-30 | R-33 | R-38 | R-49 | R-44 |
| .72 | 1.00 | .04 | .08 | R-19 | R-38 | R-40 | R-44 | R-49 | R-60 |
| .90 | 1.25 | .05 | .10 | R-19 | R-38 | R-44 | R-49 | R-57 | R-66 |

*Note.* In order to use this chart, find the zone the building is located in, determine the heating cost of the particular fuel and locate the suggested R-value that is economically feasible (ceiling).

simply find which climate zone the building is in. Select the heating cost which is usually found on monthly heating bills. Then locate the suggested insulation levels for the particular zone expressed as R-values.

After reviewing this chart, several conclusions can be made concerning heat loss or gain through conduction.

1. As energy cost increases each year, consumers can insulate more, still gaining an economic advantage.
2. Colder zones mean more insulation for winter heating efficiency.
3. Warmer zones mean more insulation for summer air conditioning.
4. Natural gas is generally less expensive to heat a home.
5. Electric resistance heating is generally more expensive to heat a home.

## Table 12.6 Typical R-values of Different Forms of Insulation Within the United States

| | R/inch | Inches Needed For R11 | R19 | R22 | R34 | R38 | |
|---|---|---|---|---|---|---|---|
| **Loose Fill** | | | | | | | |
| *Blown-Machine* | | | | | | | |
| Fiberglass | R2.25 | 5 | 8.5 | 10 | 15.5 | 17 | 2 |
| Mineral Wool | R3.125 | 3.5 | 6 | 7 | 11 | 12.5 | 1 |
| Cellulose | R3.7 | 3 | 5.5 | 6 | 9.5 | 10.5 | 1 |
| **Loose Fill** | | | | | | | |
| *Poured-Hand* | | | | | | | |
| Cellulose | R3.7 | 3 | 5.5 | 6 | 9.5 | 10.5 | 1 |
| Mineral Wool | R3.125 | 3.5 | 6 | 7 | 11 | 12.5 | 1 |
| Fiberglass | R2.25 | 5 | 8.5 | 10 | 15.5 | 17 | 2 |
| Vermiculite | R2.1 | 5.5 | 9 | 10.5 | 16.5 | 18 | 2 |
| *Batts or Blankets* | | | | | | | |
| Fiberglass | R3.14 | 3.5 | 6 | 7 | 11 | 12.5 | 1 |
| Mineral Wool | R3.14 | 3.5 | 6 | 7 | 11 | 12.5 | 1 |
| *Rigid Board* | | | | | | | |
| Polystyrene beadboard (Styrofoam) | R3.6 | 3 | 5.5 | 6.5 | 9.5 | 10.5 | 1 |
| Extruded polystyrene | R4–5.41 | 3–2 | 5–3.5 | 5.5–4 | 8.5–6.5 | 9.5–7 | 1 |
| Urethane | R6.2 | 2 | 3 | 3.5 | 5.5 | 6.5 | 8 |
| Fiberglass | R4.0 | 3 | 5 | 5.5 | 8.5 | 9.5 | 1 |
| *Foam* | | | | | | | |
| Ureaformaldehyde | R4.8 (35 degrees F) | 2.5 | 4 | 4.5 | 7 | 8 | 1 |

CONCEPT: No. 3 Homes, offices and schools account for 24% of our total energy consumption. Savings can be made through:

A. Increasing home insulation
B. Using more efficient appliances
C. Better energy management

ACTIVITY: HOME ENERGY CONSERVATION RESEARCH

MATERIALS: Pencil, paper, assorted materials on home energy conservation for students to use.

SUGGESTED PROCEDURE: This may be done individually or in groups of students. Students should study energy materials available on home conservation, make tours of inspection in their respective homes, and determine suggestions for conservation measures which might be taken in each of the following categories:

| | | |
|---|---|---|
| Windows | Fireplaces | Cooling |
| Ventilation | Doors | Heating |
| Insulation: | Water Heater | Pipes |
| Attic | Appliances | Colors |
| Walls | Lighting | Shades, Blinds, Curtains |
| Floor | Awnings | Cooking |
| Laundering | Landscaping | General |

EXPECTED RESULTS: Students will learn new and reasonable means of home energy conservation and become more conscious personally of the part they can play in home energy conservation.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9:

**CONCEPT:** No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

**ACTIVITY:**

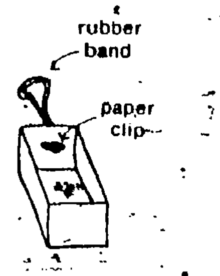
## DOES IT TAKE MORE ENERGY TO MOVE A HEAVY OBJECT OR A LIGHT ONE?

**MATERIALS:**

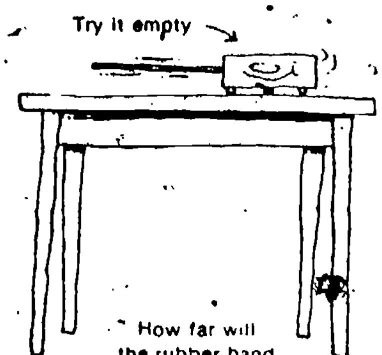
Shoe boxes; paper clips
Pencils (round ones are better)
or dowel rods
Heavy weights or books
Rubber band assortment
Metric ruler

**SUGGESTED PROCEDURE:**

1. Attach the rubber band to the shoe box so that it can be pulled along a table top.

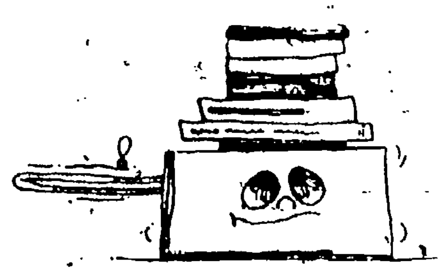



2. Measure how far the rubber band will stretch with the box empty.




3. Fill the box with some books or weights and repeat the experiment.

4. Add even more weights and repeat the experiment.



**EXPECTED RESULTS:**

The students will determine that it takes more energy to move a heavy object than a lighter one.

CONCEPT: No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

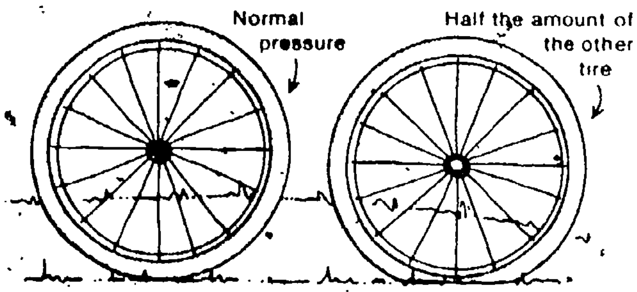
ACTIVITY: **WILL YOUR BICYCLE COAST TWICE AS FAR IF YOUR TIRES HAVE TWICE THE PRESSURE?**

MATERIALS:
Bicycle pump
Bicycles, similar type
1 Tire pressure gauge

SUGGESTED PROCEDURE:

1. Inflate one bicycle's tires to normal pressure. Inflate the other's tires to half that amount.

2. Have two students of similar weight ride side by side at the same speed. When they reach a marked line on the ground, have them coast the rest of the way.




3. Compare how far each goes.

EXPECTED RESULTS: The students will be able to determine that a bicycle will coast twice as far if the tires have twice the pressure and apply this to the importance of checking tire pressure on a car.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9:

CONCEPT: No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

ACTIVITY: SAVING GASOLINE IN TRANSPORTATION!

MATERIALS:

Gasoline Mileage Test (student copies)
Sets of Shell Answer Books
Pencil, paper, calculators (if possible)
Nomographs
Copies of attached sheets, if possible

SUGGESTED PROCEDURE:

1. Have students take the 9-question Gasoline Mileage Test and go over results.

2. Have students see how many gasoline savers they can spot in the accompanying picture.

3. Have students answer the set of attached questions. They may work individually or in groups.

EXPECTED RESULTS: Students will learn much more about saving gasoline in everyday transportation experiences.

# GASOLINE SAVER QUESTIONS

1. Make a checklist of safety and gasoline-type savers which car drivers might routinely check periodically.

2. What statistics are available concerning the 55mph speed limit? Does driving under 55 mph save fuel? Does driving under 55 mph save lives? How do you feel about this?

3. Study the pictures of the 5 types of tires. What has caused each problem? How do tires affect fuel usage and conservation?

4. What is an octaine number? Does the octaine number affect gasoline mileage?, Should a driver ever change octain numbers in the gasoline he buys?

5. What types of alternative transportation are ordinarily cheaper and fuel-conservers besides the automobile? Are there advantages/disadvantages?

6. How do you determine what gas mileage a car is getting?

7. What is a Mileage Record? What is a Nomograph. Explain how to use one.

8. How does increase in speed affect gasoline cost and fuel efficiency? What factors are involved? What do the statistics tell us is the best highway cruising speed?

9. Using the Annual Fuel Costs Chart (1981), figure in-town and highway driving costs for your current car at the approximate current gasoline cost. Have the class compare results.

10. Using the "What's Your Car;s Mileage Rating?" chart, determine whether your current car is a "miser" or "guzzler." Compare results with other class members.

11. Do the results you got in #10 question coincide with the information given on the chart which shows differences in average mileage between thirteen groups of cars?

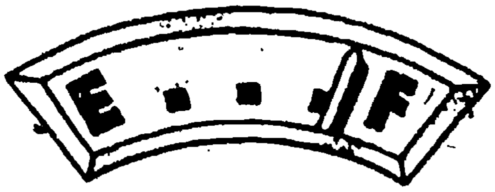
12. Why does the individual driving a car make a difference in fuel conservation (example: two boys drive the same, identical car, over the same 300-mile trip. They're mpg rate turns out several miles difference.)

13. Make a list of driving habits you notice over a two-day period which cause unnecessary fuel usage. Bring your list to class and compare with others.

14. What do you think is the most fuel efficient 1981 car on the market today? What does it cost approximately? Check an official source (Consumer Report, etc.) and see which class member was most accurate.

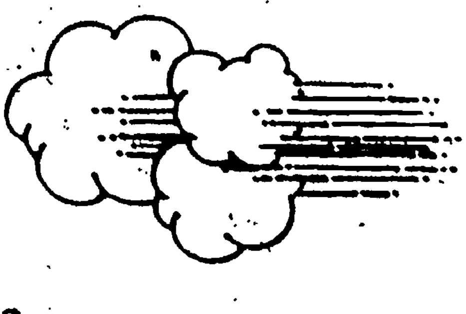
## Gasoline Mileage Test

This quiz may open your eyes or confirm your views about what effect a tune-up, grades of gasoline, tires and driving habits have on gasoline mileage. Try it.




**1.** An engine that's badly out of tune can cut gas mileage by ___%.
2%    5%    10% or more.

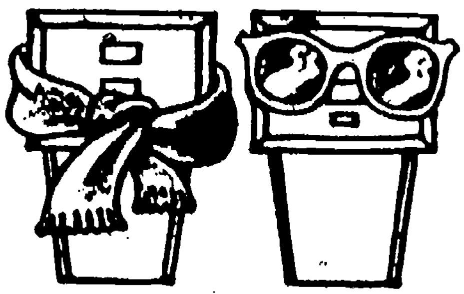
**2.** A switch from bias-ply to steel radial tires can be expected to improve gas mileage ___%.
2%    5%    7%    at least 10%.



**3.** Premium gasolines burn cleaner and give your engine more power than regular gasoline.
☐True    ☐False

**4.** A car started cold and driven only one mile will lose about ___% of the gas mileage it gets when warmed up.
10%    20%    50%

**5.** Higher octane gasoline automatically gives you better mileage.
☐True    ☐False



**6.** The same brand and grade of gasoline may vary in different areas of the country.
☐True    ☐False

**7.** A car traveling at 70 mph generally loses ___% of the gas mileage of the same car going 45 mph.
15%    25%    35%

**8.** A car may need higher octane gasoline as it gets older.
☐True    ☐False

**9.** A catalytic converter cuts mileage.
☐True    ☐False

See back cover for correct answers.

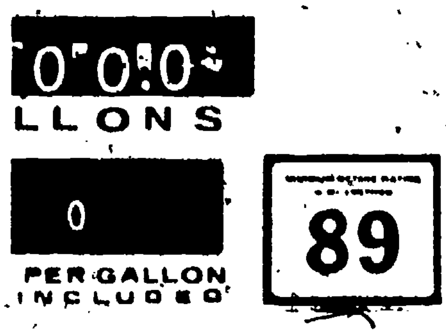
### Q. What exactly is an octane number?

**A.** It's a measure of a fuel's ability to resist knocking.

There are two standard laboratory tests for measuring the antiknock quality of automotive gasolines. They are run in the same engine, but under different conditions. The Motor octane number is measured under severe test conditions comparable to straining an engine at low speeds. The Research octane number procedure is milder, more comparable to accelerating or climbing a hill at highway speeds. It usually gives a rating six to 10 octane numbers higher than the Motor octane rating.

In the average car, a particular gasoline's antiknock ability will fall about halfway between these values. That's why an average of the Research and Motor ratings — R+M/2 — is required by law to be posted on every gas pump. This average usually falls between 87 and 95, depending on the particular brand and grade of gasoline. By the way, an engine's octane requirement will increase with age as deposits build up. So a new car that runs well on 87 octane today may require a higher octane gasoline later.

You should also know that increased octane alone will not increase an engine's power or gasoline mileage.




*The octane number you will see on gasoline pumps is an average of the Research and Motor octane ratings ( R+M/2 ). You'll see different numbers, generally from 87 to 95. Don't buy a higher octane gasoline than you need.*

### Q. Is "alternate" transportation really cheaper?

**A.** Probably several hundred dollars a year cheaper. And it could save a lot of wear and tear on your car and your nervous system. Here are some rough estimates of what you can save with alternate transportation:

1. **Car pooling** — Remember our "average" driver? Let's say he has a 20 mile round trip to and from work each day. He could save $207 a year by car pooling with just one other person. By organizing or joining a four-person car pool, he could save $310! These savings are for gasoline only.

2. **Public Transportation** — The same commuter paying $1.00 a day for the bus or train, could save over $178 a year, on gasoline alone.

3. **Motorcycle** — A man I know commutes 28 miles round-trip by motorcycle, rain or shine (except when there's ice on the road). Compared to our average car, his 50-mpg bike will save him over $400 this year on gas alone. Drawbacks? In his words, "Occasionally uncomfortable — usually dangerous."

Remember, the savings above are based on our "average" driver. The more gas *your* car uses, the more you save by *not* using it.

### Q. What about a bicycle?

**A.** Most people wouldn't care to make a 20-mile commute every day on a bicycle, but you'd be surprised how useful a bicycle can be for neighborhood errands.

As a rule of thumb, you save 10 to 20 cents a mile on gas when you ride your bike instead of using the car on a short errand.

# Put your car through this checklist

- ☐ 1. Dashboard warning lights.
- ☐ 2. Horn.
- ☐ 3. Windshield washers and wipers.
- ☐ 4. Parking brake.
- ☐ 5. Brakes. Does pedal go more than halfway to floor? Is it spongy? Does it continue to sink under pressure?
- ☐ 6. All outside lights.
- ☐ 7. Motor oil level.
- ☐ 8. Windshield washer fluid.
- ☐ 9. Power steering fluid level.
- ☐ 10. Belt condition and tension.
- ☐ 11. Battery fluid level.
- ☐ 12. Battery cable condition.
- ☐ 13. Coolant level in radiator.
- ☐ 14. Radiator and heater hoses.
- ☐ 15. Tire pressure.
- ☐ 16. Tire wear. (Are wear indicators showing? Is wear uneven?)
- ☐ 17. Shock absorber action.
- ☐ 18. Stains from leaking fluids.

# Stay alive. Drive 55.

Slowing down on the highway can save your life

Department of Transportation statistics show that the likelihood of dying in a car crash more than doubles as traveling speed increases from 55 to 70 mph.

In the three years after the government instituted the 55 mph limit, the average number of deaths from traffic accidents decreased by some 9,000 per year when compared to the previous three years

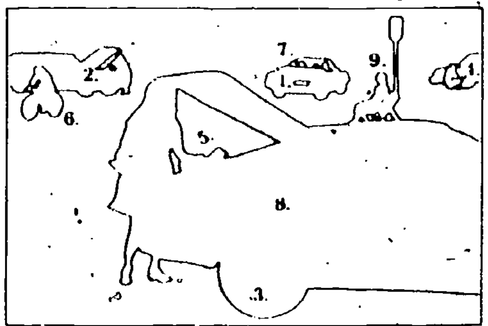
Even if saving fuel weren't so important today, the 55 mph limit's life-saving capabilities more than justify its existence

Nobody knows when — through no fault of their own — they'll be involved in an auto accident. The difference between life and death can be just a few miles per hour.

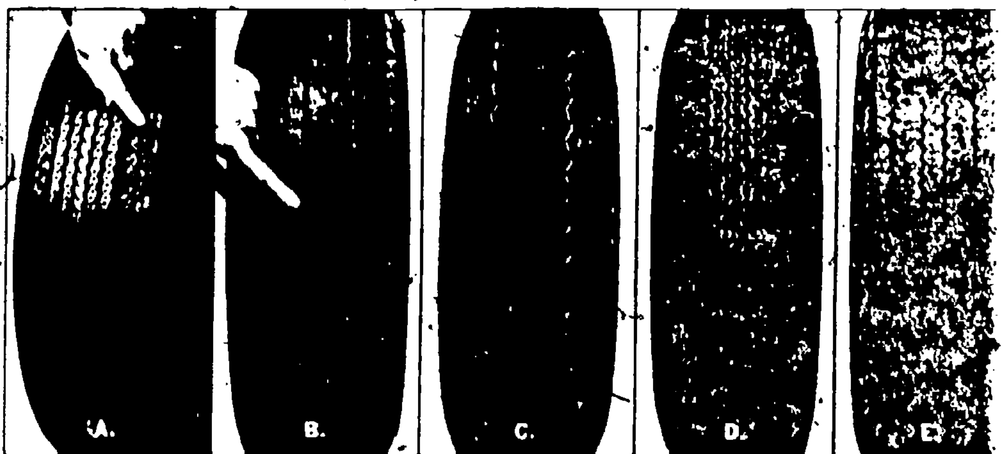
70

## Can you find the gasoline savers in this picture?

This picture proves that saving gasoline begins close to home. See if you can spot nine smart, gasoline-saving ideas here and in your own neighborhood.




**1. Don't speed.** Speeding wastes gas. Respect the 55 mph speed limit. This single step could save America a tremendous amount of gasoline. **2. Keep your engine tuned up.** A badly out-of-tune engine can waste more than 10 percent of its gasoline. **3. Ride on radial tires.** Steel-belted radials save you about 5 percent on gasoline mileage over bias ply. **4. Maintain your tire pressure.** Tires underinflated by 20 percent can cost you 5 percent in gasoline mileage, not to mention 25 percent in tread life. Check them with a pressure gauge, especially with radials. Don't just "eyeball" them. **5. Group trips together.** Visit the laundry, grocery, post office, etc., on a *single* trip. **6. Ride a bike or walk instead of driving.** It's good for your health and America's gasoline diet. **7. Carpool if you can.** You'll save both gas and money. The U.S. Department of Transportation's Federal Highway Administration estimates a driver can save from $281 to $654 a year on a 20-mile daily round trip if he or she carpools. **8. Don't buy more car than you need.** Smaller cars usually cost less and use less gasoline. Look for a high EPA mileage rating when you shop. **9. Use public transportation where you can.** Airplanes, buses and trains are often cheaper and more convenient.




*A. Bald spots or "cupping" are usually caused by out-of-balance wheels or weak shocks. B. Tread wear indicator showing across two or more grooves means tire should be replaced. It's the law in most states. C. If the center of the tread wears faster than the edges, overinflation is the cause. D. When the edges wear faster than the center, it's probably due to underinflation or hard cornering. E. Wheel misalignment can cause one edge of the tread to wear faster.*

**Q. How do I find out what gas mileage my car is getting?**

**A.** Every time you buy gas, fill the tank all the way and write down the miles showing on your car's speedometer. Divide the number of miles you drove since the last fill-up by the number of gallons you put in since your last fill-up. The answer will be your car's miles per gallon.

The mpg will probably be a little different each time because of differences in the weather, the car's condition and other factors.

When you eliminate a drive altogether, see how much gas you saved by dividing the length of the drive by your car's miles per gallon.

For a fast, easy way to calculate mpg, get a free Shell nomograph and keep it in the glove box.

A nomograph is a simple diagram that engineers sometimes use to do quick calculations. (See box on opposite page.)

## MILEAGE RECORD

| Date | Gals | Odometer Reading | Miles Traveled | MPG |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## 12 TIPS FOR GOOD MILEAGE

1. Accelerate slowly
2. Minimize braking by anticipating need to slow or stop
3. Reduce cruising speeds (above 40 MPH)
4. Turn corners slowly
5. Don't vary speed unnecessarily
6. Do not "exercise" gas pedal
7. Consolidate short trips
8. Minimize idling when starting up
9. Avoid prolonged idling (RR crossing, traffic jam etc.)
10. Shift into high as soon as possible
11. Keep engine in good tune
12. Keep tire pressure up

Shell

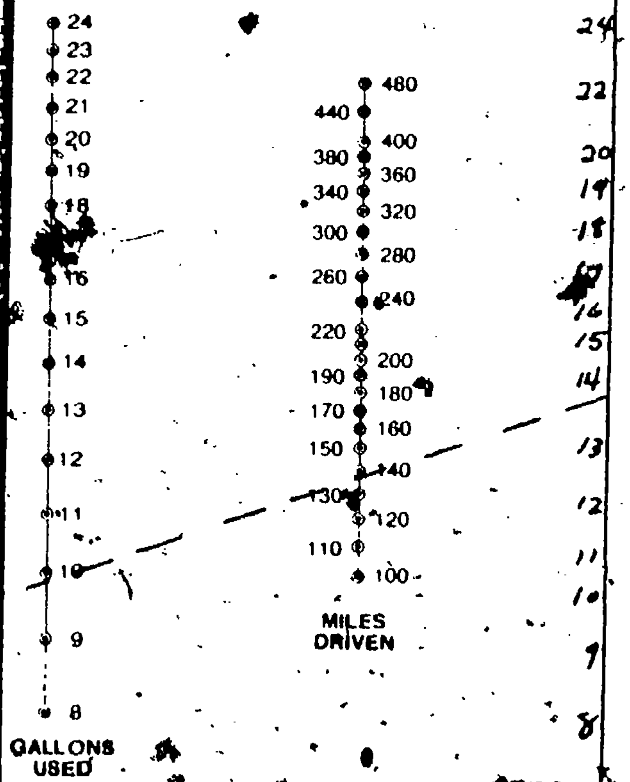
**TO USE**

Calculate miles per gallon only between fillups when the car is level and the tank is filled nearly to overflowing.

Record the gallons and miles traveled *since* the previous fillup.

Using any straight edge (card, paper, envelope, map), line up the gallons used (left scale), with the miles driven (center scale) and read the miles per gallon (right scale).

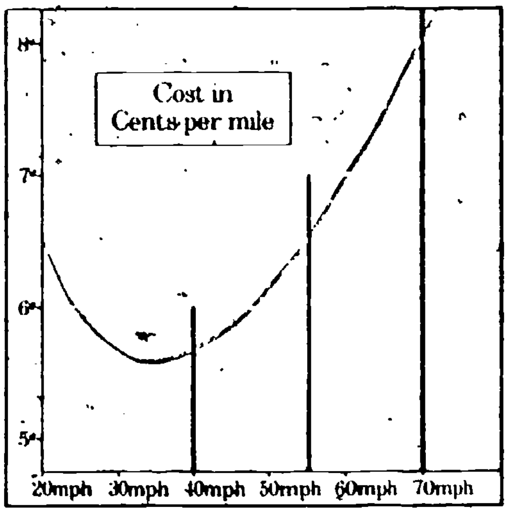
Example (dotted line) shows 10 gallons to drive 140 miles, or 14 miles per gallon.



## ANNUAL FUEL COSTS CHART

**For 1981 Model Year**
**Based on 15,000 Miles Per Year**

| Est. MPG | Dollars Per Gallon 1.75 | 1.65 | 1.55 | 1.45 | 1.35 | 1.25 | 1.15 |
|---|---|---|---|---|---|---|---|
| 50 | 525 | 495 | 465 | 435 | 405 | 375 | 345 |
| 49 | 536 | 506 | 474 | 444 | 413 | 382 | 352 |
| 48 | 546 | 515 | 484 | 452 | 421 | 390 | 359 |
| 47 | 559 | 527 | 495 | 463 | 431 | 399 | 367 |
| 46 | 570 | 537 | 505 | 472 | 439 | 407 | 374 |
| 45 | 583 | 549 | 516 | 483 | 450 | 416 | 383 |
| 44 | 596 | 562 | 528 | 494 | 460 | 426 | 392 |
| 43 | 612 | 577 | 542 | 507 | 472 | 437 | 402 |
| 42 | 625 | 589 | 553 | 518 | 482 | 446 | 411 |
| 41 | 640 | 604 | 567 | 531 | 494 | 458 | 421 |
| 40 | 656 | 619 | 581 | 544 | 506 | 469 | 431 |
| 39 | 672 | 634 | 595 | 557 | 518 | 480 | 442 |
| 38 | 690 | 651 | 611 | 572 | 533 | 493 | 454 |
| 37 | 709 | 668 | 628 | 587 | 547 | 506 | 466 |
| 36 | 730 | 688 | 646 | 605 | 563 | 521 | 480 |
| 35 | 751 | 708 | 665 | 622 | 579 | 536 | 493 |
| 34 | 772 | 728 | 684 | 639 | 595 | 551 | 507 |
| 33 | 795 | 750 | 704 | 659 | 614 | 568 | 523 |
| 32 | 819 | 772 | 725 | 679 | [illegible] | 585 | 538 |
| 31 | 848 | 799 | 751 | 703 | 654 | 606 | 557 |
| 30 | 874 | 824 | 774 | 724 | 674 | 624 | 574 |
| 29 | 906 | 854 | 802 | 750 | 699 | 647 | 595 |
| 28 | 937 | 884 | 830 | 776 | 723 | 669 | 616 |
| 27 | 971 | 916 | 860 | 805 | 749 | 694 | 638 |
| 26 | 1011 | 953 | 895 | 837 | 780 | 722 | 664 |
| 25 | 1050 | 990 | 930 | 870 | 810 | 750 | 690 |
| 24 | 1095 | 1032 | 970 | 907 | 844 | 782 | 719 |
| 23 | 1142 | 1077 | 1011 | 946 | 881 | 816 | 750 |
| 22 | 1194 | 1126 | 1058 | 990 | 921 | 853 | 785 |
| 21 | 1250 | [illegible] | 1107 | 1035 | 964 | 892 | 821 |
| 20 | 1312 | 1238 | 1162 | 1088 | 1012 | 938 | 862 |
| 19 | 1381 | 1302 | 1223 | 1144 | 1065 | 986 | 907 |
| 18 | 1460 | 1376 | 1293 | 1209 | 1126 | 1042 | 959 |
| 17 | 1544 | 1455 | 1367 | 1279 | 1191 | [illegible] | 1014 |
| 16 | 1641 | 1547 | 1453 | 1359 | 1266 | 1172 | 1078 |
| 15 | 1751 | 1651 | [illegible] | 1451 | 1351 | 1251 | 1151 |
| 14 | 1874 | 1767 | 1660 | 1553 | 1446 | 1339 | 1232 |
| 13 | 2019 | 1903 | 1788 | 1673 | 1557 | 1442 | 1327 |
| 12 | 2187 | 2062 | 1937 | 1812 | 1687 | 1562 | 1437 |
| 11 | 2386 | 2250 | 2113 | 1977 | 1841 | [illegible] | 1568 |
| 10 | 2625 | 2475 | 2325 | 2175 | 2025 | 1875 | 1725 |
| 9 | 2916 | 2750 | 2583 | 2416 | 2250 | 2083 | 1946 |




This graph shows the relationship between speed and gasoline cost for our average car. As you can see, the cost increase between 55 mph and 70 mph is almost double the increase between 40 and 55. This is mainly due to wind resistance.

| MILEAGE GROUP | SIZE | CYLINDERS | TRANSMISSION | AIR-CONDITIONER | APPROX. MPG PENALTY | ADDED GAS COST FOR 10,000 MI. |
|---|---|---|---|---|---|---|
| 1 | MINICOMPACT | 4 | MANUAL | NO | 0 | 0 |
| 2 | MINICOMPACT | 4 | MANUAL | YES | 2.5 | $15 |
| | MINICOMPACT | 4 | AUTOMATIC | NO | | |
| 3 | MINICOMPACT | 4 | AUTOMATIC | YES | 5 | $32 |
| | SUBCOMPACT | 4 | MANUAL | NO | | |
| 4 | SUBCOMPACT | 4 | MANUAL | YES | 7 | $48 |
| | SUBCOMPACT | 4 | AUTOMATIC | NO | | |
| 5 | SUBCOMPACT | 4 | AUTOMATIC | YES | 9.5 | $74 |
| | SUBCOMPACT | 6 | MANUAL | NO | | |
| | COMPACT | 6 | MANUAL | NO | | |
| 6 | SUBCOMPACT | 6 | MANUAL | YES | 10.5 | $85 |
| | SUBCOMPACT | 6 | AUTOMATIC | NO | | |
| | COMPACT | 6 | MANUAL | YES | | |
| | INTERMEDIATE | 6 | MANUAL | NO | | |
| 7 | SUBCOMPACT | 6 | AUTOMATIC | YES | 12 | $104 |
| | COMPACT | 6 | AUTOMATIC | NO | | |
| | INTERMEDIATE | 6 | MANUAL | YES | | |
| 8 | COMPACT | 6 | AUTOMATIC | YES | 13 | $119 |
| | COMPACT | 8 | MANUAL | NO | | |
| | INTERMEDIATE | 6 | AUTOMATIC | NO | | |
| 9 | COMPACT | 8 | MANUAL | YES | 14 | $135 |
| | COMPACT | 8 | AUTOMATIC | NO | | |
| | INTERMEDIATE | 6 | AUTOMATIC | YES | | |
| | INTERMEDIATE | 8 | MANUAL | NO | | |
| 10 | COMPACT | 8 | AUTOMATIC | YES | 15 | $153 |
| | INTERMEDIATE | 8 | MANUAL | YES | | |
| 11 | INTERMEDIATE | 8 | AUTOMATIC | NO | 17 | $196 |
| | FULL | 8 | AUTOMATIC | NO | | |
| 12 | INTERMEDIATE | 8 | AUTOMATIC | YES | 18 | $222 |
| | FULL | 8 | AUTOMATIC | YES | | |
| 13 | LUXURY | 8 | AUTOMATIC | YES | 19 | $251 |

***How to Read.*** *This chart shows differences in average mileage between thirteen groups of cars. Group one gets the best mileage. Column six shows how much less mileage other groups get. Column seven shows the cost of the additional gasoline that a car in one of those groups would need for 10,000 miles of driving.*

***For example,*** *a car in group seven will get about 12 mpg less than a car in group one. And use about $104 worth of additional gasoline in 10,000 miles. The same car will get about 3 mpg more than a car in group 10, and by comparison would save about $49 worth of gasoline ($153 minus $104) in 10,000 miles of driving. These calculations used a national average price of 58¢ per gallon for unleaded gasoline derived from published industry price data for April 1976.*

## What's your car's mileage rating?

In each category put an "X" in the box that most closely describes your car. Score three points for each answer in the first column, two points in the second column, etc. A score of 13 to 18 rates your car a "MISER." Seven points or less means you're driving a "GUZZLER" compared to the kind of mileage you *could* be getting.

| | 3 Points | 2 Points | 1 Point | 0 Points |
|---|---|---|---|---|
| **Vehicle Type** | Subcompact Minicompact | Compact | Mid-Size | Large Car or Van |
| **Engine Type** | Small Diesel | 4-Cylinder | 6-Cylinder Diesel V-8 Small V-8 | Large V-8 |
| **Accessories** | Manual Trans. no Air | Manual Trans. with Air | Auto Trans. no Air | Auto Trans with Air |
| **Tire Type and Pressure** | Radials Correct Pressure | Radials Underinflated | Bias or Bias-Belted Correct Pressure | Bias or Bias-Belted Underinflated |
| **Engine Condition** | Starts Easily and Runs Smoothly | Rough Idle | Poorer than Normal Acceleration | Cuts Out When Accelerating |
| **Oil Type** | Gas-Saving Multigrade | Ordinary Multigrade | 30 Weight | 40 Weight |

| IF YOU: | YOU CAN SAVE: |
|---|---|
| • Pool with three friends, 40 miles round trip. (*1,2) | $ 728 per year; 43.3 gallons per month<br>$ 60.67 per month (*3) |
| • Use public transportation to commute 30 miles round trip (*1,2) | $ 364 per year; 44.0 gallons per month<br>$ 30.33 per month |
| • Downsize to a 1981 compact from your 1977 mid-size and obtain 50% better mileage | $ 329 per year; 19.6 gallons per month<br>$ 27.42 per month |
| • Pool with a friend, 10 miles each way (*2) | $ 242 per year; 14.4 gallons per month<br>$ 20.00 per month |
| • Reduce one five mile errand daily for six days | $ 217 per year; 12.7 gallons per month<br>$ 17.72 per month |
| • Keeping your new set of radials properly inflated, reduce one errand daily | $ 177 per year; 10.6 gallons per month<br>$ 14.79 per month |
| • Reduce one errand daily for six days, two miles round trip | $ 107 per year; 6.3 gallons per month<br>$ 8.89 per month |
| • Next car trade, buy a 4-cylinder engine model instead of a 6 or 8 | $ 67 per year; 4.0 gallons per month<br>$ 5.55 per month |
| • Drive at 55 mph | $ 60 per year; 3.6 gallons per month<br>$ 5.04 per month |
| • Install radials when replacing tires | $ 50 per year; 3.5 gallons per month<br>$ 4.93 per month |
| • Cut off air conditioning (*4) | $ 25 per year (4 warmest months) |

*NOTES:
(1) Fare of $1.50 a day is subtracted from these figures.
(2) Some additional savings in parking would occur.
(3) Longer radial tire life totally offsets higher price.
(4) TEA staff computation based on a study done by the city of Baltimore.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9:

CONCEPT: No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

ACTIVITY: EFFECT OF SPEED ON FUEL CONSUMPTION RATES

MATERIALS: Student copies of attached chart and questions. Pencils.

SUGGESTED PROCEDURE: Have students study information on chart.

Let them answer questions.

Check answers and discuss findings.

EXPECTED RESULTS: Students will learn the effects of speed on fuel consumption in automobiles.

EFFECT OF SPEED ON FUEL CONSUMPTION RATES

| Test Car Number and Weight (in lbs.) | Miles Per Gallon At Selected Speeds | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 |
| 1 (2,400) | 22.74 | 21.94 | 22.22 | 21.08 | 17.21 |
| 2 (4,800) | 17.12 | 17.20 | 16.11 | 14.92 | 13.13 |
| 3 (3,500) | 19.30 | 18.89 | 17.29 | 15.67 | 13.32 |
| 4 (5,240) | 18.33 | 19.28 | 15.62 | 14.22 | 12.74 |

_________ 1. What is this form of presentation called?
- a. a case study
- b. a graph
- c. a table
- d. a simulation

_________ 2. What does this information show?
- a. The number and weight of cars in the United States.
- b. Miles per gallon for different cars at various speeds.
- c. How fast some cars can go.
- d. Heavier cars consume less fuel at all speeds.

_________ 3. Which car had the higest gasoline consumption at 40 MPH?
- a. Car 1
- b. Car 2
- c. Car 3
- d. Car 4

_________ 4. Which car had the highest gasoline consumption at 70 MPH?
- a. Car 1
- b. Car 2
- c. Car 3
- d. Car 4

_________ 5. How are the numbers in miles per gallon related to the consumption of gasoline?
- a. The higher the miles per gallon number, the higher the gasoline consumption per mile.
- b. The higher the miles per gallon number, the lower the gasoline consumption per mile.
- c. The number of miles per gallon is not related to the gasoline consumption.

_________ 6. For what change of speed did the greatest increase in fuel consumption occur for all test cars?
- a. Between 30 and 40 MPH
- b. Between 40 and 50 MPH
- c. Between 50 and 60 MPH
- d. Between 60 and 70 MPH

_____ 7. Which of the following has little or no effect on the amount of gas a car consumes per mile?
a. weight of the car
b. speed it is driven at
c. brand of gasoline it uses
d. horsepower of its engine

_____ 8. The amount of oil which we import each year is
a. decreasing each year.
b. increasing each year.
c. provided mostly by Canada.
d. coming mostly from Alaskan wells.

_____ 9. Which of the following would NOT be considered when we talk about energy supply?
a. The amount of a resource already discovered and known.
b. Whether it can be extracted with present methods.
c. How much it costs to extract it.
d. Past patterns of consumption.

# CONSERVATION OF ENERGY: HOME AND SCHOOL

GRADES 7-9:

CONCEPT: No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

ACTIVITY: DOES THE 55 MPH SPEED LIMIT SAVE ENERGY?

MATERIALS: Student copies of attached materials:

a. Student questions
b. Data sheet
c. Student calculators, if possible

SUGGESTED PROCEDURE: Follow instructions given for the various activities given on the attached sheets.

See Teacher Edition of sheets for background and related materials.

EXPECTED RESULTS: Students will be able to analyze data, evaluate, identify factors, and come to decisions about the 55 mph speed limit.

# Activity: - Does the 55 MPH Speed Limit Save Energy?

Student Questions

1. How many gallons of gasoline could be saved by driving an average car 100,000 miles at 50 mph instead of at 70 mph?

2. What are the causes of the increase in gasoline consumption as speed increases?

3. Identify some other possible benefits of lower highway speeds.

4. List some negative aspects of the 55 mph speed limit.

5. Would it be reasonable to set a speed limit of 30 mph? 40 mph?

Effect of Speed on Fuel Consumption Rates
Automobiles

| Test Car Number and Net Weight (lbs.) | Miles Per Gallon At Selected Speeds | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 |
| 1 (4,880) | 17.12 | 17.20 | 16.11 | 14.92 | 13.13 |
| 2 (3,500) | 19.30 | 18.89 | 17.29 | 15.67 | 13.32 |
| 2A (3,500) | 21.33 | 21.33 | 18.94 | 17.40 | 15.36 |
| 3 (3,540) | 23.67 | 24.59 | 20.46 | 14.83 | 13.42 |
| 4 (3,975) | 18.25 | 20.00 | 16.32 | 15.77 | 13.61 |
| 5 (2,450) | 31.45 | 35.19 | 33.05 | 30.78 | 22.82 |
| 6 (3,820) | 22.88 | 19.41 | 20.28 | 17.78 | 14.88 |
| 7 (3,990) | 15.61 | 14.89 | 16.98 | 13.67 | 11.08 |
| 8[1] (2,050) | (24.79) | (27.22) | (26.80) | (24.11) | N.A. |
| 9 (2,290) | 21.55 | 20.07 | 19.11 | 17.83 | 16.72 |
| 10 (2,400) | 22.72 | 21.94 | 22.22 | 21.08 | 17.21 |
| 11 (5,250) | 18.33 | 19.28 | 15.62 | 14.22 | 12.74 |
| 12 (4,530) | 20.33 | 20.00 | 17.90 | 16.17 | 14.86 |
| Average (Unweighted) | 21.05 | 21.07 | 19.49 | 17.51 | 14.93 |

[1] Since vehicle #8 could not be operated satisfactorily at 70 miles per hour, its miles per gallon performances were omitted from the averages. They are, however, given in parentheses.

# Does the 55 MPH Speed Limit Save Energy?

**Overview**

In this lesson students will examine the fuel savings of the 55 MPH speed limit. There are three activities in this lesson.

Activity 1 is a brief class discussion in which the students take a straw vote on whether they think that fuel is saved by driving at 55 MPH instead of 70 MPH.

Activity 2 is a small group activity. The students are given a data table showing the gas mileage of several cars driven at selected speeds. They answer questions asking them to apply the data and consider possible causes for the fuel savings at lower highway speeds.

Activity 3 is a teacher-led discussion. Ideas formulated by the students about the benefits and drawbacks of slower highway speeds are presented. Factual material is supplied by the teacher to expand the students' ideas.

These activities are intended for use in General Science or Physics courses, but investigating the energy savings can be taught in a social studies classroom.

**Objectives**

Students should be able to:

1. analyze data concerning fuel consumption and speed.
2. evaluate the relationship between fuel consumption and speed.
3. identify the major factors affecting fuel consumption at different speeds.
4. evaluate positive and negative aspects of the 55 MPH speed limit.

**Materials**

Class copies of the student questions and data sheet
Student calculators, if possible

Suggested Time — 1-2 class periods

Teaching Strategies

Activity 1 - One way to begin this lesson on the subject of saving energy by driving slower is to present a brief history of motor vehicle speeds and speed limits.

History of Cars and Speed

The first automobile in the United States was driven in 1893. Almost immediately, man set out to see how fast he could make it go. By 1894 people were talking about an automobile race. The first race took place one year later in Chicago. It was a 52 mile race with the winner averaging 5.05 MPH.

By 1900, when cars were first produced in any large quantity, 10 MPH was considered a reasonable speed on the open road. In 1901, New York and Connecticut passed the first motor vehicle speed limit laws in the United States. The speed limits were 8 MPH in the cities and 15 MPH on the open road. These laws also contained a provision that a motorist, upon meeting a horse, must pull to the side of the road and, if necessary, turn off the motor to allow the horse to pass. These early speed laws were passed mainly to pacify the non-motorists who complained of the noise and dust as opposed to modern day speed limits that are designed to protect the motorist from himself and from other motorists. Now, of course, speed limits are imposed to conserve fuel, too.

From the very early car speeds of 5 MPH, cars quickly became capable of higher speeds. In 1904, Henry Ford set a world's land speed record of over 93 MPH! By this time, highway speeds were about 15 MPH, mostly because the road system was not designed or constructed for automobile traffic. They were more suitable for horse and buggy travel. Very few paved roads existed. However, road construction for automobile traffic began about 1900 and has continued until the present time. Speed and speed limits continued to increase as a network of paved roads grew across the nation.

\- Department of Transportation

Motivating Learning

The motivating question to get students thinking about fuel savings might be: Is fuel saved by driving at 55 MPH rather than 70 MPH? Take a straw vote in Yes/No columns on the chalkboard, allowing for qualified votes. Some students may say, for example, that fuel is saved by driving cars at 55 MPH, but not trucks. Accept this viewpoint without discussion at this time. A separate vote could be taken for trucks, if the class wishes.

Note: The class may agree that fuel is saved by driving slower. In this case, the straw vote might center around how much saving there is. The most useful form for expressing the savings is in miles per gallon (MPG), although percentage or dollars could be used.

Activity 2 - A good approach to this activity is to break the class into small groups of 3-5 students each. Distribute the student worksheets and data tables. Most students should complete the work without the teacher's assistance, although some may need help with the calculations in Question 1.

Activity 3 - This activity involves the whole class in a discussion of the conclusions reached in the previous activity. The discussion centers around the amounts of fuel saved, the causes for the savings, and the societal impact of the controversial 55 MPH speed limit.

Teachers' Manual

Effect of Speed on Fuel Consumption Rates
Automobiles

| Test Car Number and Net Weight (lbs.) | Miles Per Gallon At Selected Speeds | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 |
| 1 (4,880) | 17.12 | 17.20 | 16.11 | 14.92 | 13.13 |
| 2 (3,500) | 19.30 | 18.89 | 17.29 | 15.67 | 13.13 |
| 2A (3,500) | 21.33 | 21.33 | 18.94 | 17.40 | 15.36 |
| 3 (3,540) | 23.67 | 24.59 | 20.46 | 14.83 | 13.42 |
| 4 (3,975) | 18.25 | 20.00 | 16.32 | 15.77 | 13.61 |
| 5 (2,450) | 31.45 | 35.19 | 33.05 | 30.78 | 22.82 |
| 6 (3,820) | 22.88 | 19.41 | 20.28 | 17.78 | 14.88 |
| 7 (3,990) | 15.61 | 14.89 | 16.98 | 13.67 | 11.08 |
| 8[1] (2,050) | (24.79) | (27.22) | (26.80) | (24.11) | N.A. |
| 9 (2,290) | 21.55 | 20.07 | 19.11 | 17.83 | 16.72 |
| 10 (2,400) | 22.72 | 21.94 | 22.22 | 21.08 | 17.21 |
| 11 (5,250) | 18.33 | 19.28 | 15.62 | 14.22 | 12.74 |
| 12 (4,530) | 20.33 | 20.00 | 17.50 | 16.17 | 14.86 |
| Average (Unweighted) | 21.05 | 21.07 | 19.49 | 17.51 | 14.93 |

[1]Since vehicle #8 could not be operated satisfactorily at 70 miles per hour, its miles per gallon performances were omitted from the averages. They are, however, given in parentheses.

Answers to Student Questions

1. How many gallons of gas could be saved by driving a car 100,000 miles at 50 mph instead of 70 mph?

*In order to do this calculation the students first need to change miles per gallon into gallons per mile.*

*This is a reciprocal relationship*

$$\frac{\text{miles}}{\text{gallon}} = \frac{1}{\frac{\text{gallons}}{\text{mile}}}$$

$$\text{At 70 mph, } 14.93\ \frac{\text{miles}}{\text{gallon}} = \frac{1}{14.93}\ \frac{\text{gallons}}{\text{mile}}$$

$$\frac{1}{14.93} = .051 \quad (1\ 0\ 14.93 = .051) \text{ so}$$

$$14.93\ \frac{\text{miles}}{\text{gallon}} = .051\ \frac{\text{gallons}}{\text{mile}}$$

$$\text{At 50 mph, } 19.49\ \frac{\text{miles}}{\text{gallon}} = 19.49\ \frac{\text{gallons}}{\text{mile}} =$$

$$.067\ \frac{\text{gallons}}{\text{mile}}$$

$$.067\ \frac{\text{gallons}}{\text{mile}} - .051\ \frac{\text{gallons}}{\text{mile}} = .016\ \frac{\text{gallons}}{\text{mile}}$$

*(at 50 MPH) (at 70 MPH) (saving)*

$$.016\ \frac{\text{gallons}}{\text{mile}} \times 100{,}000 \text{ miles} = 1600 \text{ gallons}$$

*Roughly one billion intercity highway miles are travelled each day in the United States. One billion is 10,000 times 100,000. The savings in gas for 100,000 miles that the students calculated can be multiplied by 10,000 to find the daily savings for a national reduction in speed from 70 mph to 50 mph.*

*1600 gallons x 10,000 = 16,000,000 gallons*

*The savings in money per day or per week that can be realized by the average individual driver are not great. The average American car is driven 10* *high speed miles per day. Using the figure of .016 gallons/mile saved by driving at 50 mph instead of 70 mph, the weekly savings is only 1.1 gallons (about 67¢ if gasoline is 60¢ a gallon). This amounts to about $35 a year. At the present time motorists have no difficulty purchasing 20 gallons at a time, so 1.1 gallons is not a very noticeable savings. As our petroleum reserves dwindle causing a rise in the price of gasoline and/or rationing, this 1 gallon saved per week may become more important to the individual.*

*On a national level, 16 million gallons of gasoline saved each day is significant. However, an enforced speed limit is necessary to achieve this fuel savings. The immediate savings to an individual is not enough to make a voluntary slow-down program work for very long.*

*The national speed limit of 55 mph yields a slightly smaller fuel than 50 mph would (11 million gallons per day vs. 16 million). The speed limit was set at 55 mph to provide better fuel economy while not seriously upsetting the interstate truck industry.*

2. What are the causes of the increase in gasoline consumption as speed increases?

   *The two most important causes are the increase with speed in the rolling resistance and the air drag. These two terms are defined below.*

*Rolling Resistance: This means what it says, it is the resistance to rolling and is caused by friction between the moving parts in the drive train (the transmission and differential), in the axle and wheel bearings and between the tires and the road. It is a resisting force which the engine must overcome. The important thing to know is that it gets bigger as the wieght of the car increases and that while it does not change very much with speed while the car is traveling slower than 40 mph, it increases rapidly (as the square of the increase) above 40 mph. This latter change is probably caused by changes that occur in automobile tires as speed increases. Above 40 mph most automobile tires begin to deform. A great deal of energy goes into setting up wavelike motions in the tire rather than moving the automobile.*

*Air Drag: Air drag or air resistance is also a force which the engine must overcome. It depends* on the shape of the car and on its speed. The important factors are (1) that streamlining reduces the drag and (2) that the drag goes up as the square of the speed. (This means that doubling the speed quadruples the air drag.) Air drag is a larger factor in the loss of gas mileage at high speeds than rolling resistance. This is especially true for trucks which are usually not streamlined at all.

Streamlining of automobiles began with the ill-fated Chrysler Airflow in the 1930's. Since that time autos have become continually more "sleek" and "aerodynamic." Unfortunately, real reductions in air drag have not been as great as appearances might indicate. One major reason is probably that while stylists have smoothed out the part of the car that we see, the underside of the car is the same rough, irregular shape that it was in the 1930's. A few automobiles (Porsche 904 and Jaguar E-type) have been produced with a smooth "belly-pan" and these cars have relatively low drag coefficients.

3. Identify other possible benefits of lower highway speeds.

<u>SAVES LIVES</u>

The lowered speed limit has reduced the automobile death rate. The actual number of accidents has not been significantly reduced. Accidents are less serious at lower speeds which results in fewer serious injuries and deaths.

<u>TIRES</u>

Tires wear longer at speeds under 40 mph. Tires deform above that speed and their rate of wear is accelerated.

<u>MECHANICAL COMPONENTS</u>

The engine, transmission, differential, and wheel bearings all run at lower temperature at lower speeds. Wear rate on these components increases as temperature increases. The lowered speed limit allows these things to run slower and cooler, so they can last longer.

Students may identify other hidden benefits. The ones mentioned here are measurable and important ones.

4. List some negative aspects of the 55 mph speed limi[illegible]

*Wasted t[illegible] boredom are the two things that students [illegible] often identify. These complaints are very important from an energy standpoint. Our lifestyle has developed around the ability to do things and go places rapidly. Energy has not been considered in our pursuit of speed. Students need to be aware that rapid travel carries an energy penalty and that our supplies of energy are finite. Some change in our lifestyle is necessary if we are going to change our level of energy usage.*

5. Would it be reasonable to set the speed limit at 30 mph? At 40 mph?

*The answer to this question is no at the present time. There is little if any fuel saving by driving at speeds under 50 mph. There would also be extremely negative public reaction to such a drastic change in driving habits even if it represented a large fuel savings. Intercity trucks would be seriously affected by such a low speed limit.*

Trucks

Trucks have not been emphasized in the above discussion because they account for only 1/4 of the total energy used anually in intercity highway travel. Fuel consumption data is provided for trucks to show students that fuel is saved by operating trucks at lower highway speeds. However, truck drivers are governed by regulations that do not apply to automobile drivers. The effects of these regulations must be considered along with fuel consumption in any discussion of whether a given speed limit is reasonable.

Safety regulations include mandatory rest stops and a 10 hour per day driving limit. Truck shipping routes and terminal locations were established considering these regulations, but with a speed limit of 60-70 mph. The safety regulations prevent truck drivers from compensating completely for the longer time that is necessary to make a given trip at lower speeds.

Present terminal locations require that a round trip between points 200 miles apart be possible in

**CONCEPT:** No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, weight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

**ACTIVITY:** CARPOOLING!

**MATERIALS:** Pencil, paper, and questions (may be written on chalkboard)

**SUGGESTED PROCEDURE:**

1. Have students work on the following problems on an individual basis.
2. Compare answers and lead a discussion.

Background: Carpooling - About 1/3 of all private auto usage is for commuting to and from work.

Problem 1: Four students carpool each day of the 175-day school year. Each lives about 5 miles from the school they attend. What is the number of miles each saves in driving if all share equally taking turns driving?

Gas sells for $1.25 per gallon. John's car gets 15 mpg. Sue's - 17 mpg. Bill's - 20 mpg. Lee's 30 mpg. Calculate each student's fuel cost for the school year for their part in the carpool. How much more in fuel costs can Lee expect to save than John?

Problem 2: Carpooling has several advantages for conservation of energy. List as many advantages as you can. What are some of the inconveniences of carpooling?

**EXPECTED RESULTS:**

Students will become aware of conservation possibilities through the use of carpooling.

CONCEPT: No. 4 Transportation accounts for 25% of our total energy consumption. Savings can be made through:

A. Reducing auto size, eight
B. Improving driving habits
C. Improving commuter habits
D. Encouraging mass transit

ACTIVITY: **REWARDS OF CARPOOLING**

MATERIALS: Materials related to carpooling, pencil, paper

SUGGESTED PROCEDURE:

1. Let students make lists concerning the pros/cons of carpooling.
2. Have them figure out math problems related to carpooling in various situations:

   school, work, recreation, neighborhood

3. Let them figure out savings from a carpooling situation and how long it would take them to save enough to buy a much-desired item.
4. Let them work out a plan for Nashville for carpooling (to work) for the city's inhabitants. How would it be implemented. What incentives would be planned for carpool participants.
5. What "tips" can they arrive at to make carpooling more workable and pleasant for those who join the carpool?

EXPECTED RESULTS: Students will learn more about carpooling in a variety of situations and devise creative "pros" for carpooling.

| If you can do this... | It might save you this. | Then you could spend the money on something like this. |
|---|---|---|
| 1. Next time you need tires, buy a set of steel-belted radials instead of bias-plies.[1,2] | 3.5 gal. per month<br>$4.93 per month<br>$59 per year | **With one month's savings:** A package of good golf balls. Subscriptions to one newsweekly and two monthly magazines.<br>**With one year's savings:** An electric blanket. A video game cartridge. Four gourmet cooking lessons. |
| 2. Drive 55 instead of 70.[1] | 3.6 gal. per mo.<br>$5.04 per mo.<br>$60 per year | **Month:** An extra long-distance call. A separate phone for the kids.<br>**Year:** A decorator phone. A programmable calculator. A 3-man tent. A CB radio. |
| 3. Order a 4-cylinder engine instead of a 6 in your next car. | 4.0 gal. per mo.<br>$5.55 per mo.<br>$67 per year | **Month:** Steak on a hamburger night. A pound of chocolates. Two new cans of tennis balls.<br>**Year:** A cassette tape recorder. A watch. A food processor. |
| 4. Eliminate one errand per day, two miles round trip. (6 days per week.)[1] | 6.3 gal. per mo.<br>$8.89 per mo.<br>$107 per year | **Month:** Burgers, fries and shakes for two. A paperback book club selection.<br>**Year:** Somebody to mow your lawn all summer. A rod and reel. A 15-pound box of gourmet steaks. A terrific tennis racquet. |
| 5. Use steel radials, eliminate a trip a day (combination of 3 and 4, above), and keep the tire pressure up.[1] | 10.6 gal. per mo.<br>$14.79 per mo.<br>$177 per year | **Month:** Cable TV. Movie tickets for two adults and two children plus popcorn.<br>**Year:** A phone-answering machine. A telescope. A car stereo cassette player. A video game. |
| 6. Eliminate one 5 mile trip per day. (6 days per week.)[1] | 12.7 gal. per mo.<br>$17.72 per mo.<br>$217 per year | **Month:** A board game. A real crystal wine glass. A Save the Children Federation sponsorship.<br>**Year:** A new suit. A baby sitter 18 extra times. A shotgun. |
| 7. Car pool with one other person, 10 miles each way.[1] | 14.4 gal. per mo.<br>$20.18 per mo.<br>$242 per year[3] | **Month:** Cable TV with special movie channel. Two or three bottles of wine.<br>**Year:** Two season tickets on the 40-yard line. A backyard gas grill. A home movie camera. |
| 8. Replace your 1977 mid-size car with a 1981 compact and get 50 percent better mileage. | 19.6 gal. per mo.<br>$27.42 per mo.<br>$329 per year | **Month:** A 1976 proof set for your coin collection. Fancy perfume.<br>**Year:** A stereo. A 35mm camera. A microwave oven. Steel-belted radial tires (see item 1). |
| 9. Use public transportation to commute 15 miles each way.[1] | 44.0 gal. per mo.<br>$30.33 per mo.<br>$364 per year[3,4] | **Month:** A fancy house plant. A trip to the hairdresser.<br>**Year:** Vacation plane tickets. Luggage. Golf clubs. A saw, a drill, and a sander. |
| 10. Car pool with three other people, 20 miles each way.[1] | 43.3 gal. per mo.<br>$60.67 per mo.<br>$728 per year[3,4] | **Month:** A fine china place setting. Dinner out for two.<br>**Year:** A new sofa for your living room. A dishwasher. A big color TV. |

See note explanations on back cover.

Examples are based on a hypothetical "typical" driver. He drives 10,000 miles per yr, 6,000 city, 4,000 highway. 1977 mid-size car gets 12.5 mpg city and 17.7 mpg. highway, overall average 14.2 mpg. He purchases 704 gallons of gas at $1.40 per gallon. Total expenditure $985.60. There would probably be additional savings on parking. $1.50 per day for fare has already been subtracted from these figures.

**Q. Just how much money can I save by carpooling?**

**A.** The U.S. Dept. of Transportation's Federal Highway Administration estimates a driver can save between $281 and $654 a year on a 20-mile daily round trip if he carpools. To get a rough idea of what *you* might be able to save, try this formula:

Estimate the amount of money

the number of people who'll be in your carpool. The answer is your new, lower cost of commuting.

**Q. What's a good way to keep track of the money?**

**A.** Keep a gasoline savings account in a little notebook. Divide the pages into four columns.

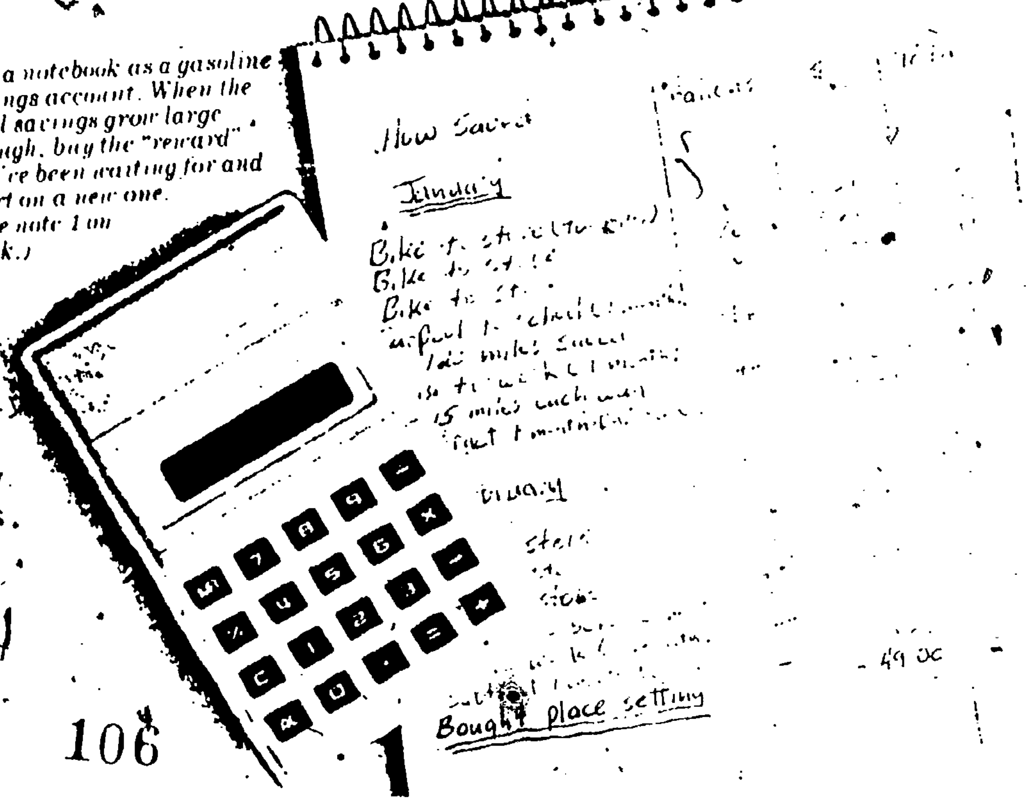
*Column one:* What you did that saved gas.

*Column two:* How much gas that saved.

*Column three:* How much money that's worth to you.

*Column four:* Total saved so far.

When column four gets big enough, go and buy the thing




*Use a notebook as a gasoline savings account. When the total savings grow large enough, buy the "reward" you've been waiting for and start on a new one. (See note 1 on back.)*

### Use this example to help compute your savings

Say you spend a couple of bucks a day on gas. Another two dollars for parking. That multiplies into a hefty sum every month.

$4 per day × 21 days = $84

| | Individ. cost per month | Savings per month |
|---|---|---|
| Carpooling with one can cut the cost in half. | $42 | $42 |
| Another person drops it even more. | $28 | $56 |
| If still another joins, your cost is even less. | $21 | $63 |

In this example carpooling saves up to $63 a month. How much could it save you?

While some purists may complain that this example doesn't include such factors as depreciation, insurance, service, maintenance and other costs, I think most will agree that it does cover the basic costs of commuting.

### America's cities high on carpooling

In **Hartford, Connecticut** a computer program offers any employer, public or private, information that can help him begin a carpool program at his company. And the State Dept. of Transportation constructs carpool-commuter parking lots at key highway intersections to make drive-ride programs easier.

In **Knoxville, Tennessee** all forms of ridesharing alleviate mass congestion. In this southern city, carpooling keeps over 22,000 cars off the road. If it were not for carpooling, the city would have to provide more parking space than is currently covered by the entire downtown area.

At the **San Francisco-Oakland** Bay Bridge, priority lanes for carpools with three or more persons speed commuters past long lines of single-occupant cars. And the carpoolers pay no tolls.

In **Omaha, Nebraska** a phone-in service makes it possible for drivers to find a carpool just by making a telephone call.

### Ridesharing makes good corporate sense

On top of environmental and economic advantages, there are other corporate advantages to carpooling.

[1] Employees get to work on time more often.

[2] It reduces the need for new parking spaces, which can be extremely expensive.

[3] Morale and work efficiency are increased because people ride to work in less congestion, in a shorter time, and with parking spaces assured or more easily available.

[4] It makes it easier for non-commuters to get downtown and to other commercial areas.

[5] It serves as a good long-term community relations project.

### Q. Is it hard to start or join a carpool?

**A.** Most of the time it's relatively easy. Especially if you work for a large company or live in a city.

At Shell's downtown Houston offices, almost 70 percent of my 4800 co-workers carpool. The majority of them joined a carpool at work. Some simply got together with their neighbors on their own.

Check your place of business. There may already be a carpool system in effect. If you live in a city, find out if there's a computer matching system or a local American Automobile Association that can put you in touch with people going your way.

Put up notes in local [illegible], libraries, supermarkets — wherever personal notices can be posted. If none of these approaches pan out, write "Double Up," U.S. Department of Transportation (HA-[illegible]), Washington, D.C. 20590. The [illegible] the Highway Users Federation can give you information about [illegible] community or employer can organize a carpooling program.

# Energy

## WORDS

# GLOSSARY of energy terms

**barrel** – A liquid measure of oil, usually crude oil, equal to 42 gallons or about 306 pounds.

**base load** – The minimum load of a utility (electric or gas) over a given period of time.

**bioconversion** – A general term describing the conversion of one form of energy into another by plants or micro-organisms. It usually refers to the conversion of solar energy by photosynthesis.

**bio-fuel** – A fuel derived from plant materials.

**biomass** – Plant materials in any form, from algae to wood.

**British thermal unit (BTU)** – An engineering unit of heat energy, the quantity of heat necessary to raise the temperature of one pound of water to one degree Fahrenheit.

**catalytic converter** – A device added to the exhaust system of an automobile that converts the air pollutants, carbon monoxide (CO) and hydrocarbons (HC), to carbon dioxide ($CO_2$) and water. A similar conversion also removes nitrogen oxides ($NO_X$).

**chain reaction** – A reaction that stimulates its own repetition. In a fission chain reaction a fissionable nucleus absorbs a neutron and splits in two, releasing additional neutrons. These in turn can be absorbed by other fissionable nuclei, releasing still more neutrons and maintaining the reaction.

**coal gasification** – The conversion of coal to a gas suitable for use as fuel through the application of heat and pressure.

**coal liquefaction** – The conversion of coal into liquid hydrocarbons, usually by the addition of hydrogen.

**crude oil** – A mixture of hydrocarbons in liquid form found in natural underground petroleum reservoirs. It has the heat content of 1.46 million calories per barrel and is the raw material from which most refined petroleum products are made.

**declining block rate** – A method of charging for electricity whereby a certain number of kilowatt hours (the first block) is sold at a relatively high rate and succeeding blocks at lower and lower rates. Thus the charge for energy decreases as the amount consumed increases.

**deuterium** – A non-radioactive isotope of hydrogen whose nucleus contains one neutron and one proton, is therefore about twice as heavy as the nucleus of normal hydrogen which consists of a single proton. Deuterium is often referred to as "heavy hydrogen."

**efficiency** – The efficiency of an energy conversion is the ratio of the useful work or energy output to the total work or energy input.

**energy** – A quantity having the dimensions of a force times a distance. It is conserved in all interactions within a closed system. It exists in many forms and can be converted from one form to another. Common units are calories, joules, BTU's and kilowatt-hours.

**fission** – The splitting of heavy nuclei into two parts (which are lighter nuclei), with the release of large amounts of energy and one or more neutrons.

**fluidized bed** – A furnace design in which the fuel is buoyed up by air and some other gas. It offers advantages in the removal of sulfur during combustion.

**fossil fuels** – Fuels such as coal, crude oil, or natural gas, formed from the fossil remains of organic materials.

**fusion** – The formation of a heavier nucleus by combining two lighter ones.

**generating capacity** – The capacity of a power plant to generate electricity, usually measured in megawatts (MW).

**geothermal energy** – The heat energy in the earth's crust whose source is the earth's molten interior. When this energy occurs as steam, it can be used directly in steam turbines.

**greenhouse effect** – The warming effect of carbon dioxide and water vapor in the atmosphere. These molecules are transparent to incoming sunlight but absorb and reradiate the infrared (heat) from the earth.

**heat pump** – A device that transfers heat from a cooler area to a warmer one (or vice versa) by the use of mechanical or electric energy. Heat pumps work on the same general principle as refrigerators and air conditioners.

**horsepower** – Originally, the power output of a typical working horse. Equal to 3/4 of one kilowatt or 0.18 calories per second.

**hot rock reservoir** – A potential source of geothermal power. The "hot rock" system requires drilling deep enough to reach heated rock and then fracturing it to create a reservoir into which water can be pumped.

**hydrocarbons** – Molecules composed of carbon and hydrogen atoms in various proportions. They are usually derived from living materials.

**inverted block rate** – A method of selling electricity whereby a first block of kilowatt hours is offered at low cost and prices increase with higher consumption.

**kilowatt (kw)** – A unit of power, usually used for electric power, equal to 1,000 watts.

**kilowatt-hour (kw-hr)** – A unit of work or energy. Equivalent to the expenditure of one kilowatt in one hour, about 853 calories.

**lifetime energy cost** – Cost of energy required to operate any energy-converting device during its lifetime.

**liquefied natural gas (LNG)** – Natural gas that has been cooled to approximately minus 160° centigrade, a temperature at which it's liquid. Since liquefaction reduces the volume of the gas some 600 times, the costs of storage and shipment are reduced.

**load factors** – The percentage of capacity actually utilized, for example, the average number of passengers for a certain size car divided by the passenger capacity of that size car.

**megawatt (mw)** – A unit of power. A megawatt equals 1,000 kilowatts, or 1 million watts.

**methane gas** – A light hydrocarbon; an inflammable natural gas with a heat value of 275 calories/cubic feet. It is the major component of natural gas but can be manufactured from crude oil or other organic materials.

**methanol** – A volatile, water-soluble, flammable liquid alcohol.

**net energy** – The amount of energy produced minus the energy needed to produce it.

**nuclear energy** – The energy released during reactions of atomic nuclei.

**nuclear reactor** – A device in which a fission chain reaction can be initiated, maintained and controlled.

**nucleus** – The extremely dense, positively charged core of an atom. It contains almost the entire mass of an atom, but fills only a tiny fraction of the atomic volume.

**ocean thermal energy conversion (OTEC)** – A process of generating electrical energy by harnessing the temperature differences between surface waters and ocean depths.

**"off-peak" power** – Power generated during a period of low demand.

**oil shale** – A sedimentary rock containing a solid organic material called kerogen. When oil shale is heated at high temperatures, the oil is driven out and can be recovered.

**passenger mile** – The measure used to state the amount of BTU energy needed to carry one passenger for one mile.

**peak demand period** – That time of day when the demand for electricity from a power plant is at its greatest.

**peak load** – The maximum amount of power delivered during a stated period of time.

**peak load pricing** – Charging more for delivery of power during the daily period in which demand is greatest.

**petroleum** – An oily, flammable liquid that may vary from almost colorless to black and occurs in many places in the upper strata of the earth. It is a complex mixture of hydrocarbons and is the raw material for many products.

**photosynthesis** – The process by which green plants convert radiant energy (sunlight) into chemical potential energy.

**photovoltaic process** – The process by which solar energy is converted directly into electrical energy. Solar radiation striking certain materials is absorbed, causing separation of electrons from atoms. The migration of these electrons in one direction and of the positively charged electron vacancies ("holes") in the other can produce a small potential difference or voltage, typically about 0.5 volts.

**power** – The rate at which work is done or energy expended. It is measured in units of energy per unit of time such as calories per second, and in units such as watts and horsepower.

**recoverable resource** – That portion of a resource expected to be recovered by present-day techniques and under present economic conditions. Includes geologically expected but unconfirmed resources as well as identified reserves.

**reserve** – That portion of a resource that has been actually discovered but not yet exploited and is presently technically and economically extractable.

**secondary recovery** – Recovery techniques used after some of the oil and gas has been removed and the natural pressure within the reservoir has decreased.

**solar cell** – A device which converts radiant (solar) energy directly into electrical energy by the photovoltaic process. Each cell produces about 0.5 volts and about 0.6 watts of power.

**solar energy** – The electromagnetic radiation emitted by the sun. The earth receives about 4,200 trillion kilowatt-hours per day.

**stack gas scrubber** – Device which removes sulfur dioxide from gases produced by coal combustion.

**synthetic natural gas (SNG)** – A gaseous fuel manufactured from coal. It contains almost pure methane, and can be produced by a number of coal gasification techniques.

**synthetic oil** – Oil produced from liquefaction of coal.

**tar sands** – Sandy substance mixed with low-grade oil.

**tertiary recovery techniques** – Use of heat and other methods to augment oil recovery (presumably occurring after secondary recovery).

**thermal storage** – A system which utilizes ceramic brick or other materials to store heat energy.

**thermodynamics** – The science and study of the relationship between heat and other forms of energy.

**ton-mile** – The term used in measuring the amount of BTU energy needed to haul one ton one mile.

**topping cycle** – A way to use high temperature heat energy that cannot be used in a conventional steam turbine. A gas turbine, for instance, might operate as a topping cycle on furnace gases of 2000° F and its exhaust could then heat steam for a turbine operating at 1000° F.

**total energy system** – Energy system using either high-efficiency gas-fired turbines or engines which generate electricity; exhaust heat from the turbines or engines is used for heating or cooling.

**tritium** – A radioactive isotope of hydrogen with a half-life of 12.5 years. The nucleus contains one proton and two neutrons. It may be used as a fuel in the early fusion reactors.

**uranium** – A heavy, naturally occurring, radioactive nucleus of atomic number 92. Uranium isotope $235_U$ is used as fission fuel.

**watt** – A metric unit of power usually used in electric measurements which gives the rate at which work is done or energy expended.

Additional Energy Words and Terms:

ATOM- The basic building block of all matter, an atom is the smallest particle of an chemical element (such as iron, hydrogen,gold,or uranium) that still has the properties of that element.
BREEDER REACTOR-A nuclear reactor that makes more nuclear fuel than it uses, by changing certain atoms that will not split into atoms that will split.
BUTANE-A gaseous hydrocarbon produced synthetically from petroleum and used as a household fuel, refrigerent, areosol propellent, and in the manufacture of synethic rubber.
COAL-A solid fuel,mostly carbon,formed from the fossils of plants living hundreds of millions of years ago.
COMBUSTION-The burning of a substance to cause it to release its energy in the form of heat.
CONSERVATION-Planned management of a natural resource to prevent exploitation,destructment, or neglect.
COOLANT-Anything pumped through a nuclear reactor to cool it or absorb the heat it produces. Common coolants are water,air,helium, and liquid sodium metal.
CRITICAL MASS-The smallest amount of nuclear fuel,like uranium,that will sustain a nuclear chain reaction of splitting atoms.
DEEP MINING-Mining that must be performed by digging underground shafts and tunnels.
DIRECT ENERGY CONVERSION-The process of changing any other form of energy into electricity without machinery that has moving parts. For example,a battery changes chemical energy into electricity by direct energy conversion .
D O E-Department of Energy.
DOMESTIC-Having to do with the home or homeland.
EFFIENCY,THERMAL-A measurement of how efficiently any device changes heat into another energy form. For example,a modern coal-burning electricty plant has about 38% thermal efficiency because just under 4/10 of the heat from burning the coal is actually changed into electricity.
ETHANOL-An alcohol,used as a fuel.
FISSION PRODUCTS-The smaller atoms formed when atoms fission or split.
FLY ASH-Tiny particles of solid ash in the smoke when fuels such as coal are burned.
FUEL-Anything that can be burned or fissioned to produce heat energy.
FUEL CELL-A device similar to a battery in which fuels such as hydrogen gas or methane can be directly combined with oxygen to produce electricity and very little heat; the principal by products of the process are water or carbon dioxide.
GAS COOLED REACTOR-A nuclear reactor that is cooled by a gas like air or helium,rather than by water or other liquid.
GASEOUS DIFFUSION-A process by which natural uranium is enriched and becomes a better nuclear fuel.

GENERATOR-A machine that generates or makes electricity. It uses mechanical energy from falling water or steam to spin a turbine that turns a coil of wire in the presence of a magnetic field. When this happens an electrical current is produced.

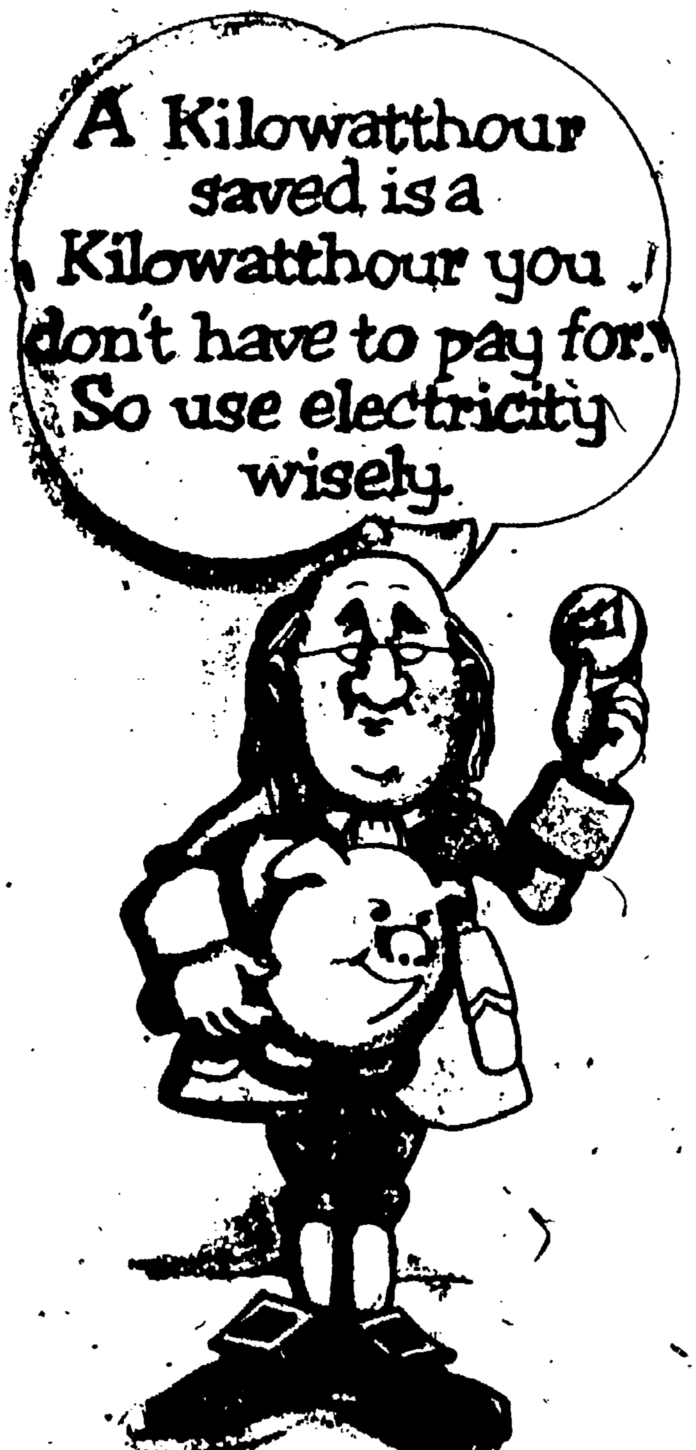
HORSEPOWER-A unit that measure the rate at which energy is produced or used. A man doing heavy manual labor produces energy at a rate of about .08 horsepower.
GEOTHERMAL STEAM-Steam formed by underground water seeping through hot rocks deep beneath the earth's surface.
INSULATION-Any material used to prevent the passage or leakage of electricity, heat or sound.
MATTER-Substance that occupies space and has weight.
Moderator-Material, such as water and graphite, used in a nuclear reactor to slow the speed of neutrons produced when atoms split.
MPH-Miles per hour.
NATURAL GAS-Gaseous fuel formed from the fossils of ancient plants and animals; often found with crude oil.
Neutron-A tiny particle, extremely heavy for its size, often found in the nucleus of an atom. Neutrons have no electrical charge, and are released when atoms split (fission).
Nomograph-A graphic representation that consists of several lines marked off to a scale and arranged in such a way that by using a straightedge to connect known values on two lines, an unknown value can be read at the point of intersection with another line.
NOTP-Nuclear Operator Training Program.
NUCLEAR POWER-The energy produced by splitting atoms (such as uranium) in a nuclear reactor.
NRC-Nuclear Regulatory Commission.
OCTANE-Any of several isomeric liquid paraffin hydrocarbons.
ODOMETER-An instrument used for measuring distances traveled.
PLUTONIUM-A heavy, man-made, radioactive metal that can be used for fuel in a nuclear reactor.
PROPANE-A colorless gas found in natural gas and petroleum.
PROLYSIS-The burning of solid wastes at high temperatures without oxygen.
R-VALUE-Resistance to heat transfer.
RADIOACTIVITY-A spontaneous change in the nucleus or center of an atom, accompanied by the release of energy called nuclear radiation.
REACTOR-The part of a nuclear power plant in which the nuclear reaction takes place and is controlled.
RECLAMATION-Recovery or restoration to a better or more usable state.
RECYCLING-The process of reusing some discarded item in a useful way.
REFORESTATION-Planting new trees on land once forested.
RESERVES-Energy resources which have actually been discovered and can be recovered.
SOLAR POWER-Electricity, heat or other useful energy produced from sunshine.
STEAM ELECTRIC PLANT-An electric power plant (either nuclear or one that burns coal or other fuel) in which heat boils water into steam, the steam is used to turn a turbine, and the turbine turns a generator to produce electricity.
STRIP MINING-Mining for coal or useful ores by removing the soil and rock found above them, rather than by tunneling underground.
SURFACE MINING-Asynonym for strip mining.
THERMAL POLLUTION-Harmful effects to the environment that may be produced by the warm water released by electric power plants into nearby lakes, rivers, or oceans.

THERMOGRAM-A photographic record made by using heat.

THERMOSTAT-An automatic device for regulating temperature of a heating or cooling unit.

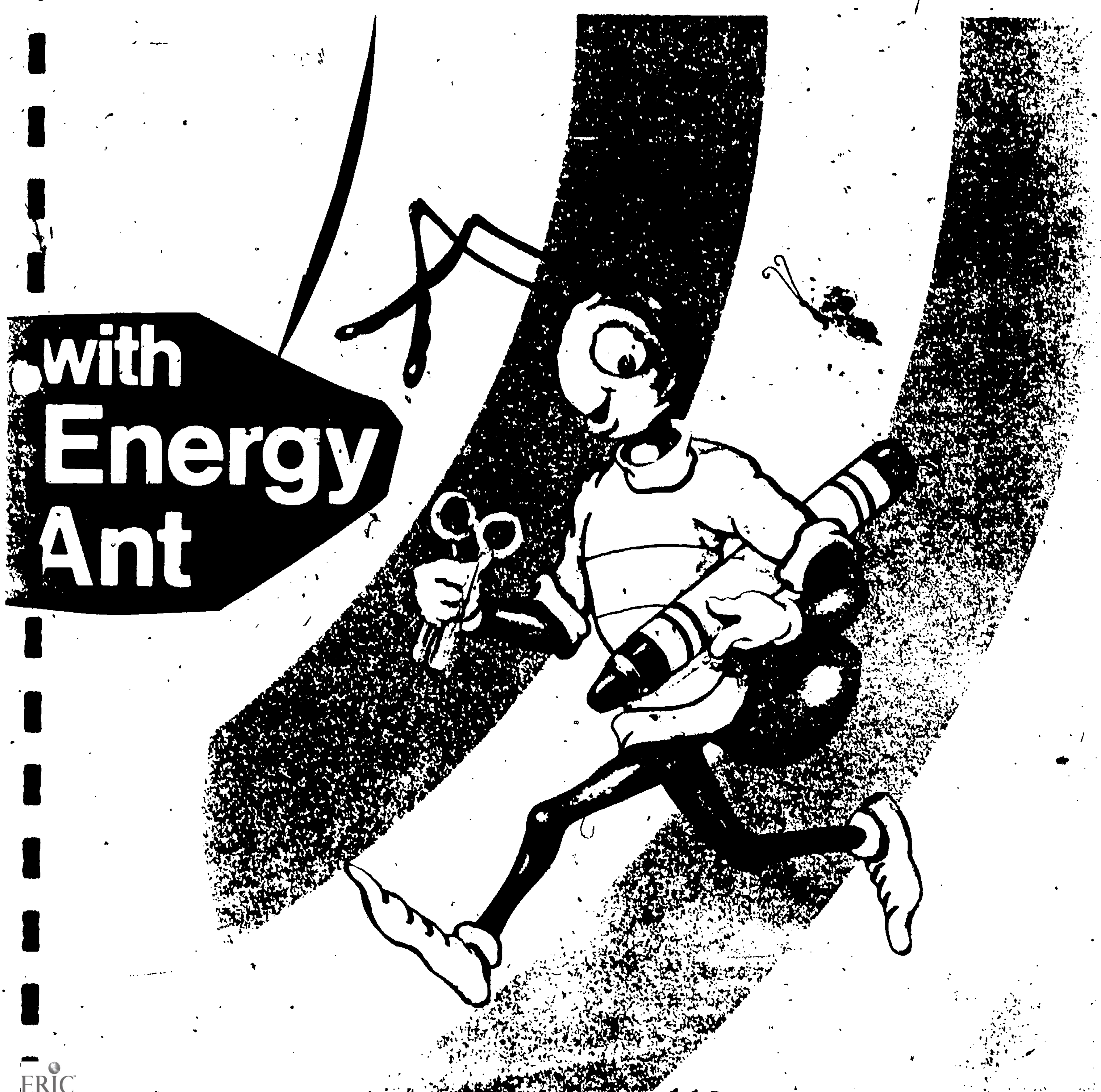
TURBINE-A wheel-shaped engine fitted with a series of curved blades. The force of running water or jets of steam hits the blades and turns them. Giant turbines turn the generators that produce the electricity in our electric power plants.

WASTES, RADIOACTIVE-A by-product of producing power by splitting atoms in a nuclear power plant; some of these materials are highly radioactive and stay radioactive for long periods of time.



78

# Looking for Energy? A Guide to Information Resources



# ENERGY SOURCEBOOK

# Where to go for help

NATIONAL GEOGRAPHIC does not necessarily endorse all the references below. They are merely a sampling of many viewpoints. For other references, see *Readers' Guide to Periodical Literature* and *Books in Print* in your public library. Write to: ENERGY, U. S. Government Printing Office, Washington, D. C. 20401, for a free list, "Energy Guides From Uncle Sam."

## BOOKS


Blandy, Thomas, and Denis Lamoureux. *All Through the House: A Guide to Home Weatherization*. New York: McGraw-Hill Book Co., 1980.

Byalin, Joan. *Women's Energy Tool Kit: Home Heating, Cooling and Weatherization*. New York: Consumer Action Now Inc., 1980.

Crowley, Maureen, ed. *Energy: Sources of Print and Nonprint Materials*. New York: Neal-Schuman Pubs., Inc., 1980.

*Energy in America's Future: The Choices Before Us*. Project Director Sam H. Schurr. Baltimore, Md.: Johns Hopkins Univ. Press, 1979.

*Energy in Transition 1985-2010: Final Report of the Committee on Nuclear and Alternative Energy Systems, National Research Council*. Published for National Academy of Sciences. San Francisco, Calif.: W. H. Freeman & Co., 1980.

*Energy: The Next Twenty Years*. Study Group Chairman Hans H. Landsberg. Cambridge, Mass.: Ballinger Publishing Co., 1979.

Hollander, Jack M., Melvin K. Simmons, and David O. Wood, eds. *Annual Review of Energy*. Palo Alto, Calif.: Annual Reviews, Inc., 1979.

*Integral Urban House: Self-Reliant Living in the City*. By the Farallones Institute. San Francisco, Calif.: Sierra Club Books, 1979.

Jeavons, John. *How to Grow More Vegetables Than You Ever Thought Possible on Less Land Than You Can Imagine*. Berkeley, Calif.: Ten Speed Press, 1979.

Loftness, Robert L. *Energy Handbook*. New York: Van Nostrand Reinhold Co., 1978.

Sant, W. Roger. *The Least-Cost Energy Strategy: Minimizing Consumer Costs Through Competition*. Pittsburgh, Pa.: Carnegie Mellon Univ. Press, 1979.

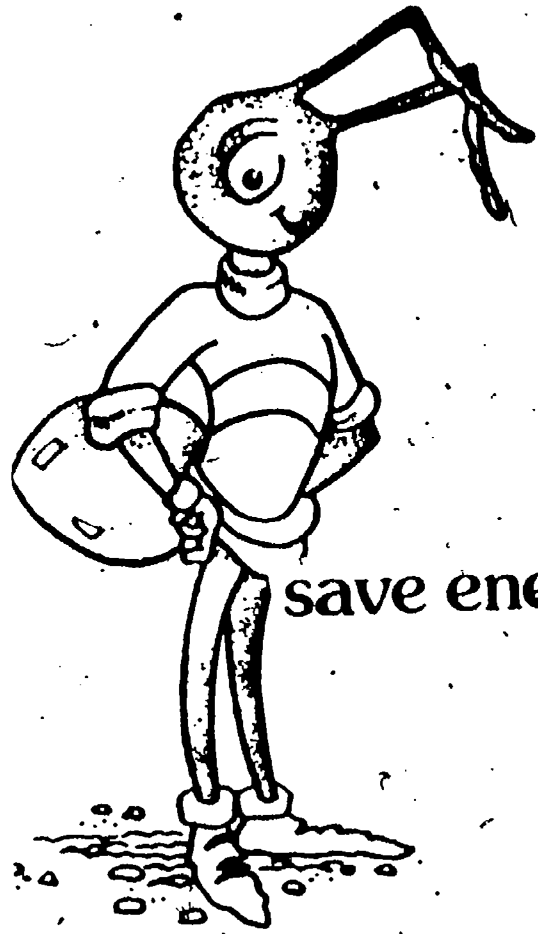
Sawhill, John C., ed. *Energy Conservation and Public Policy*. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1979.

Schelling, Thomas C. *Thinking Through the Energy Problem*. New York: Committee for Economic Development, 1979.

Stobaugh, Robert, and Daniel Yergin, eds. *Energy Future: Report of the Energy Project at the Harvard Business School*. New York: Random House, Inc., 1979.

Yanda, Bill, and Rick Fisher. *The Food and Heat Producing Solar Greenhouse*. Santa Fe, N. Mex.: John Muir Pubns.,




**SELECTED DOE PUBLICATIONS THAT HELP SAVE ENERGY AND MONEY**

**Heating with Wood,** EDM-1150
Describes the stove equipment available for burning wood safely and efficiently. Compares the heating value of different types of wood.

**How to Understand Your Utility Bill,** EDM-1085
Guide for reading electric and gas meters and checking utility bills, to learn how much energy is being used or saved. Includes operating costs of many home appliances.

**Insulate Your Water Heater and Save Fuel,** EDM-080
Recommends ways to save fuel needed to heat water, starting with adequate insulation for the hot water tank. Estimates the savings possible.

**Tips for Energy Savers,** EDM-064 (English), EDM-065 (Spanish)
Practical ways to save energy in your home, garden, workshop, and car.

**Posters**—Conservation series in color featuring children:

He Will Thank You for Conserving Energy, EDM-338
She Will Thank You for Conserving Energy, EDM-1110
They will Thank You for Conserving Energy, EDM-337 (English), EDM-3… (Spanish)

For single copies of these or other free publications, or for information on a specific energy topic, write to ENERGY, P.O. Box 62, Oak Ridge, TN 378…

DOE produces publications to fulfill a statutory mandate to disseminate information to the public on all energy sources and conservation technologies. These materials are for public use and do not purport to present an exhaustive treatment of the subject.

ENERGY TECHNICALOGY:SOURCE OF POWER......Anthony Schwaller; Davis Publications, Worcestor, Mass.-1980. See Chapter 12-Energy Conservation.

ANALYSIS OF THE PROPOSED NATIONAL ENERGY PLAN.....August 1977. Office of Technical Assessment (OTA) Congress of the United States.

### D. References

1. From the Understanding the Atom series, a complete set of which may be obtained free by teachers by writing ERDA (formerly USAEC), P.O. Box 62, Oak Ridge, Tenn. 37830.

    *Radioactive Wastes*

2. **Nuclear Power and the Public**, Harry Foreman, editor, University of Minnesota Press, Minneapolis, Minn., 1970.

3. *Plans for the Management of AEC-Generated Radioactive Wastes,* WASH-1202(73). Division of Waste Management and Transportation, July 1973. For sale by Superintendent of Documents, GPO, price 80 cents.

1. From the Understanding the Atom series, a complete set of which may be obtained free by teachers, writing to ERDA (formerly USAEC), P.O. Box 62, Oak Ridge, Tenn. 37830.

    *Your Body and Radiation*
    *Radioisotopes and Life Processes*
    *The Genetic Effects of Radiation*

2. **Nuclear Power and the Public**, Harry Foreman, editor, University of Minnesota Press, Minneapolis, Minn., 1970.

3. *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation.* Superintendent of Documents, GPO, Price $2.75.

### D. References

1. *You–What Oil Conservation Means to You.* Booklet discussing dependence on oil and gas. Interstate Oil Compact Commission, Educational Section, P.O. Box 53127, Oklahoma City, Okla. 73105.

2. *Conserve Energy–Our Spaceship Earth–Needs More Fuel!* Comic book tells methods of home energy conservation. Single copies from Edison Electric Institute, 90 Park Ave., New York, N.Y. 10016.

1. *The Search for Tomorrow's Power,* **National Geographic**, November 1972, pp. 650 ff.

2. *Managing the Power Supply and the Environment,* Report of the Federal Power Commission's National Power Survey Task Force on Environment, July 1971. Federal Power Commission, Washington, D.C. 20426.

3. *The Significance of Arab Oil,* booklet available in single copies from League of Arab States Information Center, 35th Floor, 747 3rd Ave., New York, N.Y. 10017.

4. Energy and the Future, book giving a general view. Published by American Association for the Advancement of Science, 1973.

Conservation References." They also have a slide/tape program that was developed for use by extension service agents but can be used in the classroom, church or public service groups. Request EERC/IEP 50, The Energy Conservation in the Home "Agent Kit." The Kit contains a series of five booklets and coordinated slide/tape programs.

Materials include:

| Booklet | Slide/Tape Program |
|---|---|
| The Energy Conservation Ethic | Use and Consequences: The Energy Ethic |
| House: The Building where You Live. | Wrap Up Your Troubles in Your Old Tool Box and Save, Save, Save |
| Heating and Cooling | "Stop Thief!" |
| Food and Energy | The Energy Sandwich |
| You and Your Clothes | There's More to it Than Meets the Eye |

Price is $65.00 plus $3.00 for postage and handling.

## Energy Education Materials

The list on the following pages is only a sampling of the energy education materials developed by school systems, nonprofit organizations, and federal agencies. Three sources appear frequently and are abbreviated as follows:

DOE/TIC Department of Energy/ Technical Information Center
PO Box 62
Oak Ridge TN 37830
(For an annotated list of all DOE materials, write Education Division, DOE Consumer Affairs, 8G082, Washington DC 20585.)

ERIC Educational Resources Info. Ctr.
Document Reproduction Service
PO Box 190
Arlington VA 22210
(Prices shown are for paper copy; all ERIC materials are also available in microfiche.)

GPO U.S. Government Printing Office
Washington DC 20402
(Write for GPO's subject bibliography index and price list 36, which provide all the information needed to locate additional educational materials.)

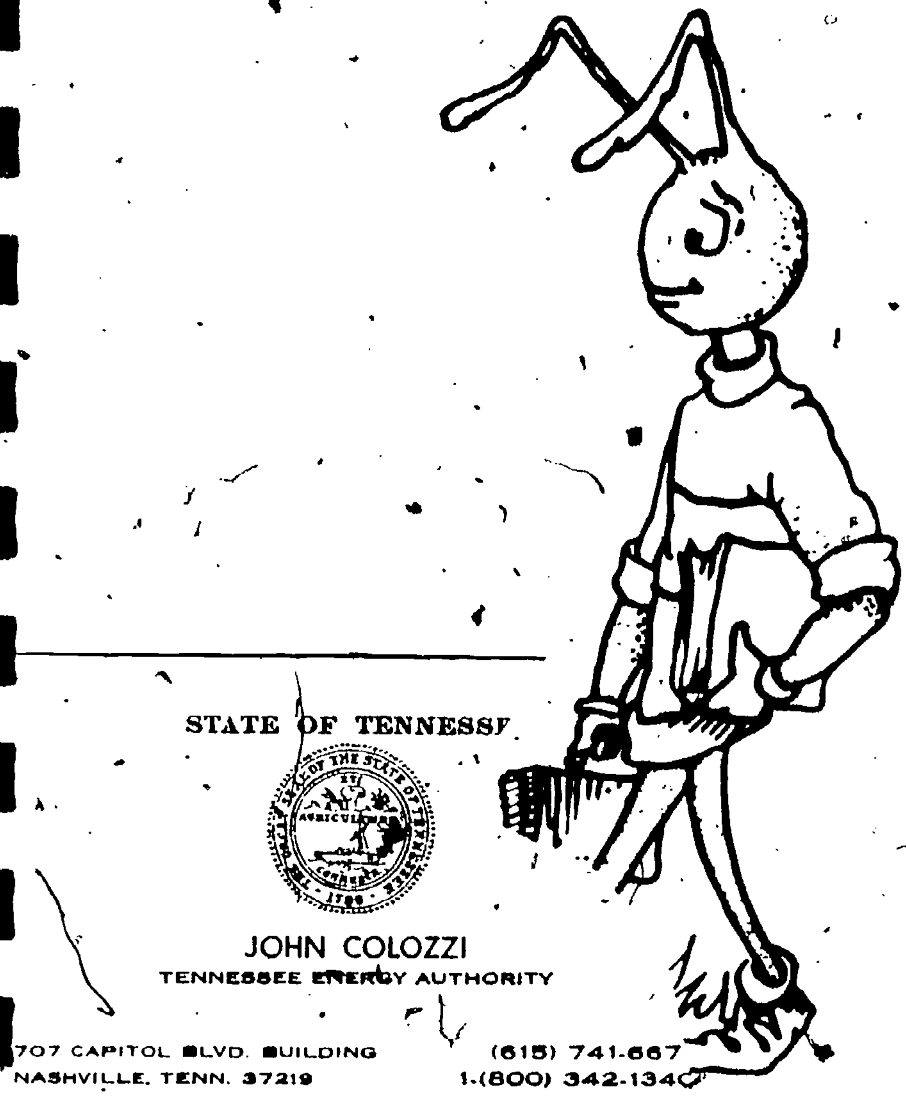
### Bibliographies, Resource Guides

Energy Directory and Bibliography. NY State Alliance to Save Energy, 36 W. 44th St., NY NY 10036. $2.50. Guide to books, magazines, and pamphlets on alternative energy sources and energy-conscious lifestyles.

Energy Education Resource Guide. Maryland State Dept. of Education. Order ED-179421 from ERIC--$4.55. Bibliography of 91 curriculum units, teacher-annotated, indexed by subject and grade, with ordering information.

Energy Education Materials Bibliography (1978; updated version available this fall.) Prepared by the Minnesota Energy Agency. Annotated bibliography of background materials and classroom activities indexed by grade level. Includes books from educational publishers, school districts, state and federal agencies. Order ED-162900 from ERIC--$4.82.

Energy Education Materials Inventory. GPO. Vol. I (thru May 1976) stock #061-000-00183-2, $5.25. Vol. II (June 1976-Dec. 1978) stock #061-000-00341-0, $8. Comprehensive annotated bibliography of K-12 energy education materials, including AV, activity packets, printed materials, background reading, other bibliographies, all with ordering information. Prepared by the University of Houston under contract to DOE's Education Division.




## Energy Conservation

Energy Conservation Activity Packets. Iowa Dept. of Public Instruction (Duane Toomsen), Grimes State Off. Bldg., Des Moines IA 50319. Free to in-state teachers attending workshops; entire set, $10; individual units, $2. Three-ring notebooks (for K-2, 3, 4, 5, and 6) of multidisciplinary activities that encourage conservation, annotated student and teacher bibliographies, worksheets, and visuals.

Ideas and Activities for Teaching Energy Conservation (7-12). Free from Univ. of Tennessee Environment Ctr., South Stadium Hall, Knoxville TN 37916. Lessons and activities for science, social studies, and language arts.

Living Within Our Means: Energy and Scarcity. K-6 and 7-12. New York State Education Dept., Albany NY 12234. Out-of-state requesters order ED-093673 (K-6, $6.32) and ED-101959 (7-12, $7.82) from ERIC. Background material for a unit in energy conservation; suggestions for teaching and special activities.

Providing for Energy Efficiency in Homes and Small Buildings, developed by the American Association for Vocational Instructional Materials for DOE. Available this fall from DOE/TIC. A training program for use in vo-tech programs or in homeowner courses offered by community colleges, the material can be used for specific instruction in energy-saving methods, integrated into construction courses, or used for self-paced instruction. Teacher guide, student workbook, and three manuals covering: understanding energy conservation, determining energy gain/loss in a building, determining the most efficient practices, installing materials.

## Project for an Energy-Enriched Curriculum

The National Science Teachers Association, with funding from DOE, has developed instructional packets designed to be integrated into existing classes and an Energy Education Workshop Handbook. In addition, NSTA has produced an Energy Environment Sourcebook for teachers ($5), and publishes a free bimonthly newsletter, Energy & Education. Sourcebook (stock #471-14692) and newsletter are available from NSTA, 1742 Conn. Ave. NW, Washington DC 20009. The following PEEC materials are available free from DOE/TIC:

Energy, Economy, & Environment Instructional Packets

For primary grades:
- The Energy We Use
- Community Workers and the Energy They Use
- Energy and Transportation

For upper elementary:
- Networks: How Energy Links, People, Goods, and Services
- Bringing Energy to the People: Washington, D.C. and Ghana
- Two Energy Gulfs

For junior high:
- Energy Transitions in U.S. History
- Energy, Engines, & the Industrial Revolution
- Mathematics in Energy
- Transportation and the City

For senior high:
- How a Bill Becomes a Law to Conserve Energy
- Agriculture, Energy and Society
- U.S. Energy Policy: Which Direction?

Award-Winning Energy Education Activities (for science and non-science classes). Brief descriptions of the winning entries to the 1976 NSTA Teacher Participation Contest.

Technical Information Center
Department of Energy
P.O. Box 62
Oak Ridge TN 37830

Request:

**Energy Challenge** (a set of 24 spirit masters for grades 5-8).

**Geothermal Energy** (a brochure which gives a brief overview of the scope and future of geothermal energy).

Request:

A subscription to **Energy and Education** (a bimonthly newsletter with information of interest to teachers of energy related topics).

* * * * * * * * * * * *

Department of Energy
Mail Stop 1E-218
Washington, DC 20585

Request:

A subscription to the **Energy Insider** (a newsletter with energy information as well as listings of new DOE energy education materials).

* * * * * * * * * * * *

Department of Energy
Office of Consumer Affairs
Room 8G082
Washington, DC 20585

Request:

A subscription to **The Energy Consumer** (a newsletter with information on federal energy programs and how much you can get involved. An especially good issue on energy education was April/May 1980.)

* * * * * * * * * * * *

Facts About Coal in Tennessee
P.O. Box 9100
Knoxville, TN 37912
615/688-6080

Request:

**Fact: We Have an Answer to the Energy Crisis** (a brochure explaining their goals and services).

Bumper Stickers

A poster entitled **Tennessee Coal is the Answer Now**


**Energy Education Program**
**324 Henson Hall, University of Tennessee**
**Knoxville, Tennessee 37916**
**Telephone: 615-974-0214**

*THE ENERGY EDUCATION PLANNER is published bi-monthly as a part of the Energy Education Program, funded through ESEA Title IV C.*
*Editor: Janice K. Kell*

*THE ENERGY EDUCATION PLANNER* **is supplied to all participating school systems and supporting organizations and is available free of charge to interested individuals and organizations. Inquiries, comments, and subscription requests should be forwarded to the address shown above.**



Energy Conservation

1. Energy: The New Era, S. David Freeman (New York: Random House) 1974.
2. Hidden Waste: Potential for Energy Conservation, David B. Lange, editor (Washington: The Conservation Foundation) 1973.
3. The American Energy Consumer, A Report to the Ford Foundation Energy Policy Project (Cambridge, MA: Ballinger) 1974.
4. The Energy Conservation Papers, Robert H. Williams, editor, Report prepared for the Ford Foundation Energy Policy Project (Cambridge, MA: Ballinger) 1974.
5. The Contrasumers: A Citizen's Guide to Resource Conservation, Albert J. Fritsch (New York: Praeger) 1974.
6. Efficient Electricity Use, Craig B. Smith (New York: Pergamon) 1976.
7. "Readings on Energy Conservation," Selected materials compiled by the Congressional Research Service for the Committee on Interior and Insular Affairs, U.S. Senate (Serial No. 94-1) (Washington:USGPO) 1975.
8. ERDA Authorization, Part I, 1976 and Transition, "Conservation," Hearings before the Subcommittee on Energy Research, Development and Demonstration of the Committee on Science and Technology, U.S. House of Representatives, 94th Congress, First Session (Washington: USGPO) 1975.

General References

1. Energy for Survival, Wilson Clark (Garden City, NY: Doubleday) 1974.
2. Energy Alternatives: A Comparative Analysis, The Science and Public Policy Program, University of Oklahoma (Washington: USGPO). May 1975. (Stock No. 041-011-0025-4; $7.45).
3. 99 Ways to a Simple Lifestyle, Center for Science in the Public Interest (Washington: CSPI) 1975.

# For More Information

Recent publications on energy and the environment which you might find of interest:


J. M. Hollander and M. K. Simmons (eds.) *Annual Review of Energy*, Vol. 1 (Palo Alto, California; Annual Reviews, Inc. 1976).

Allen Hammond, William Metz and Thomas Maugh, *Energy and the Future* (Washington: American Association for the Advancement of Science, 1973).

U. S. Council on Environmental Quality, *Energy and the Environment* (Washington: U. S. Government Printing Office, 1973).

Congressional Quarterly, *Energy Crisis in America* (Washington: Congressional Quarterly Service, 1973).

W. Wilson and R. Jones, *Energy, Ecology, and the Environment* (New York: Academic Press, 1974).

*Exploring Energy Choices: A Preliminary Report* (Washington: Ford Foundation, Energy Policy Project, 1974).

"The Energy Crisis: Reality or Myth," *Annals of the American Academy of Political and Social Science* (Vol. 410), November 1973.

*Energy Fact Book*—1976, (Arlington, Virginia: Tetra Tech, Inc. 1976).

U. S. Department of the Interior, *United State Energy Through the Year 2000* (Washington: U. S. Government Printing Office, 1972).

P. H. Abelson, (ed.), *ENERGY: Use, Conservation, and Supply*, (Washington: American Association for the Advancement of Science, 1974).

*Science* (Vol. 184), April 19, 1974 (Special issue on energy).


NATIONAL GEOGRAPHIC

SPECIAL REPORT FEBRUARY 1981

## CONTENTS

Seven booklets contained in Edison Teaching Kits

Alternative Energy Sources
Experiments You Can Do...from Edison

Energy Conservation
Experiments You Can Do...from Edison

Environmental Experiments...from Edison

Nuclear Experiments You Can Do...from Edison

Selected Experiments and Projects...from Edison

Simple Experiments on Magnetism and
Electricity...from Edison

Useful Science Projects...from Edison

**EDISON TEACHING KITS**

Withdrawn because of over-demand, these famed Kits are again available. Ideal for teachers 5 through JH, the Kit comprises seven booklets based on electrical, chemical, environmental and energy conservation experiments of Thomas Edison and other scientists.

Simple directions, inexpensive, easily obtained materials spark pupil participation. Available only through this coupon. Proven in 12,000 classrooms.

To receive your Edison Teaching Kit, mail completed coupon to Charles Edison Fund, 101 S. Harrison St., East Orange, N.J. 07018. Enclose 50 cents to cover handling.

(teacher's name, please print)

(name of School)

(address)

city state zip

# Films.

# The Home Energy Conservation Series New!

Produced by Rodale Press in association with Bullfrog Films

Three half-hour films on how to reduce fossil fuel consumption in America's 80 million existing homes!

Bullfrog Films Inc., Oley, PA 19547

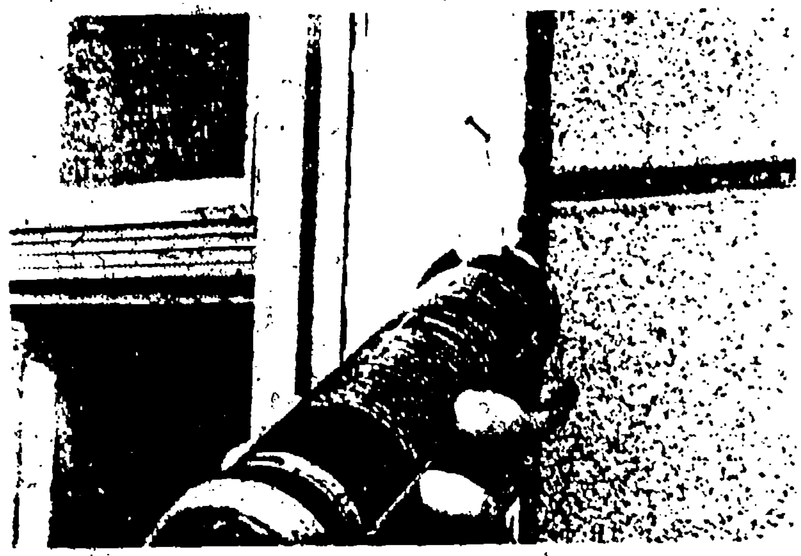
**28 Minutes Each**

Energy
Consumer Education
Science
Home Economics
Industrial Arts
Grades 7 to Adult

With Do-It-Yourself Guide for Each Film

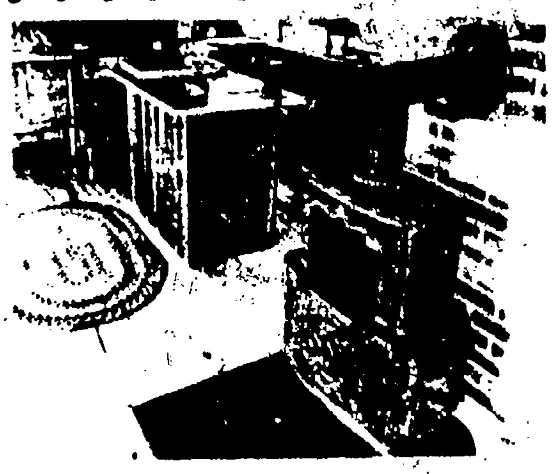
## How To Keep The Heat In Your House

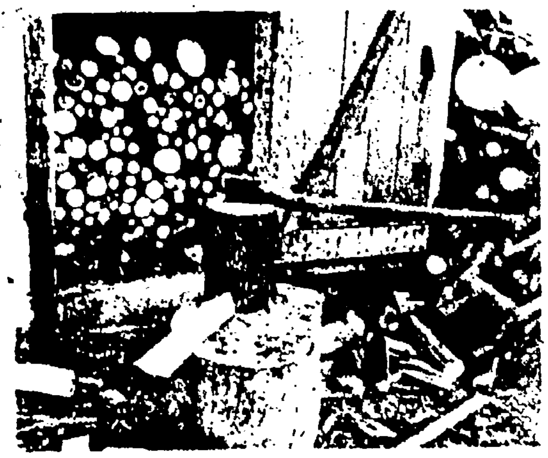
Conservation is the only viable short-term answer to the nation's energy problems. Learn how to weatherize your home . . . where to begin . . . and what measures are most cost-effective. You can save up to 50% of your fuel bills just by insulating and weatherstripping.



## Wood Heat

As the price of oil necessarily rises, there is renewed interest in heating with wood. Is it for you? Learn what's involved . . . what kind of stove best suits your situation . . . how to install it safely . . . where to get free firewood . . . how much work it takes . . . and how to manage your own woodlot.





## Opening Your Home To Solar Energy

Up to now, popular interest in solar energy has concentrated on new structures. But there are ways to utilize low-cost, passive solar techniques in existing houses. Featuring noted solar architect David Wright, this film covers everything from a simple hot air collector, to adding a picture window, enclosing your south-facing porch, building a sun room, or putting up a solar chimney for summer cooling.

***Midwest Film Conference, 1981***

# We've Got The Power

A lively and informed look at the urgent energy choice this country faces. Americans must decide whether to rely on nuclear power and fossil fuels (the "hard" path) or switch to renewable energy sources and practice conservation (the "soft" path).

Oil, coal, nuclear power, and synthetic fuels are all plagued by multiple social and environmental problems; while the soft path offers opportunities for community-controlled, environmentally-sound alternatives.

Through interviews with Amory Lovins, Barry Commoner, Winona LaDuke, and Richard Barnet, as well as community activists from Davis, Ca. to Franklin County, Mass., WE'VE GOT THE POWER documents some impressive local achievements and shows how people all over the country can work together for a safe energy future.

*"WE'VE GOT THE POWER disentangles the myths and complexities of the energy crisis and sends forth a simple, but by no means simplistic, message, grounded on conservation, decentralization, and safe renewable resources."* Senator Mark Hatfield

*Cassettes*
*Filmstrip - 2 Cassettes*
*Side A Audible Beep*
*Side B Inaudible 50 Hz*
*Slideshow - 1 Cassette (Two formats available)*
*Either Side A Audible Beep*
*Side B No Beep*
*Or Inaudible 1000 Hz*
*(Please specify)*

With Study Packet consisting of:
**Complete Script**
**Footnotes**
**Study-Action Guide**

**28 Minutes**
*140 color slides/frames*
*2-part filmstrip*
*(Available May 1981)*

Energy
Social Studies
Environment
Economics
Values
Grades 7 to Adult

Bullfrog Films Inc., Oley, PA 19547

## Energy Conservation (Suitable for kids, too)

Produced by Rodale Press/ A film by John Hoskyns-Abrahall and Winifred Scherrer

# Pedal Power

An appealing film about appropriate technology - matching the energy source to the task at hand. Do we really need a nuclear reaction to boil an egg or grind grain? The question is not as simple-minded as it may seem. For less than 10% of all the electric energy delivered in the U.S. actually requires electricity.

In light-hearted fashion, the film traces the history of pedal and treadle machines from the intuitive genius of Leonardo da Vinci, to the heyday of pedal power machines at the turn of this century, through the wishful thinking of some aeronautical pioneers, down to the present day. As the lessons of appropriate technology sink in, pedal machines are seen in action on homesteads tilling gardens and splitting wood; in heart clinics grinding grain for nutritious bread; and, in a show of power and ingenuity, as the energy source for "Gossamer Condor", in the first human-powered flight.

*Pedal Power* is a call for fresh energy thinking and human-scale technology.

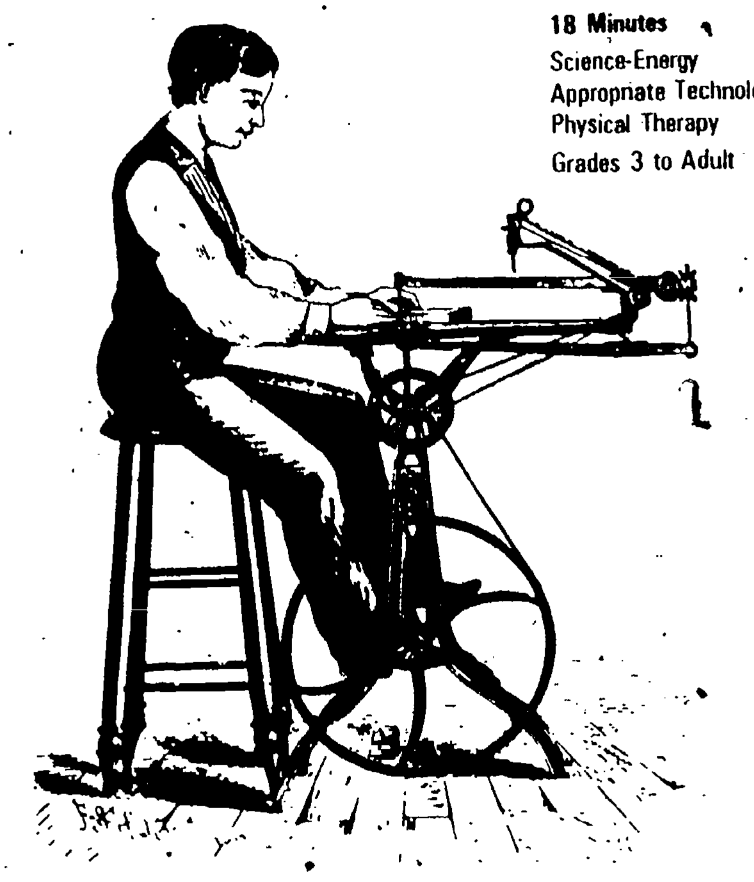
*"This film makes a very good point: it is ridiculous to spend enormous amounts of time, money, and energy developing labor-saving devices, only to find ourselves in need of physical exercise... The advocates of pedal power say that we can exercise and produce at the same time."* Reel Change

*"A good discussion film for a consideration of alternatives."* Energy and the Way We Live.

*"Best used at high school level, it has application in college courses on energy and introductory mechanics... The explanation of the efficiency of pedal power by Wilson of Oxford University is in lay terms and easy to understand."* American Journal of Physics

*"Youngsters as well as adults will find this particularly interesting because it shows how the principle of the bicycle can be used as a source of power."* U.S. Catholic Conference

With new Study Guide



**18 Minutes**
Science-Energy
Appropriate Technology
Physical Therapy
Grades 3 to Adult

# ind

Produced by the National Film Board of Canada / A film by Sidney Goldsmith

New!

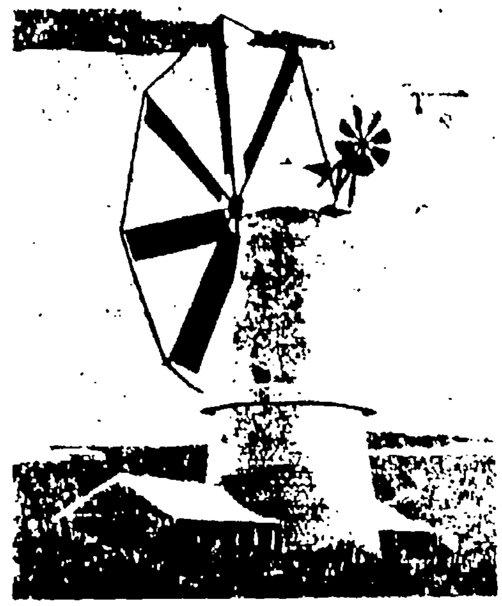
# Harness The Wind

last, here's a concise overview of the tory and potential of wind power with spectacular animation from the Oscar-winning studio at the National Film ard of Canada. The film outlines the dual refinement of wind machines from 7th century Persia down to the contemporary Darrieus rotor. It's cinating to watch the evolution design and our understanding of aerodynamic principles.

The film then projects into the future as nd power becomes a vital component our energy picture. Included are designs ranging from new water-pumping windmills to giant offshore ean platforms; from a rotor to wer household appliances to a large bank of machines designed to replace expensive diesel electric systems in the Arctic. As long as the sun shines the wind will be available.

*"This fine little film summarizes the history and potential of humankind's use of windpower . . . The film is quite well done, with excellent art work and a clear, understandable narrative. It presents wind as one form of energy and is appropriately optimistic about the potential of wind."*
Science Books & Films

*"The animation is clear and pleasant; the narration simple and easy to understand. The film will be useful in a variety of school situations - social studies, environmental science, physics, and assembly programs."* Media & Methods



**12 Minutes**
Science-Energy
Physics
Environment
Social Studies
Career Education
Grades 7 to Adult

***American Film Festival, 1980***
***Midwest Film Conference, 1980***

With Study Guide

Bullfrog Films Inc., Oley, PA 19547

# .F. Schumacher

ilm by Barrie Oldfield

New!

# n The Edge Of The orest

med in a virgin forest in Western Australia shortly before his death, E.F. Schumacher makes a powerful plea for nmon sense and good planetary havior Talking straight to the audience, he is clearly concerned that his message be understood by as many ople as possible.

irty years ago the scale of human economic activity was still small enough that it presented no lasting threat to natural environment. But if we go on isfying our wants and needs with such tremendous violence on the front line with nature, then, Schumacher says, we n classify ourselves with the en-ngered species. For all life depends on thin mantle of topsoil.

Walking through the forest of giant rah and karri trees, he reminds us of efficiency of the perfectly balanced forest ecosystem. We should marvel at it, and learn from it about long-term in our biosphere -

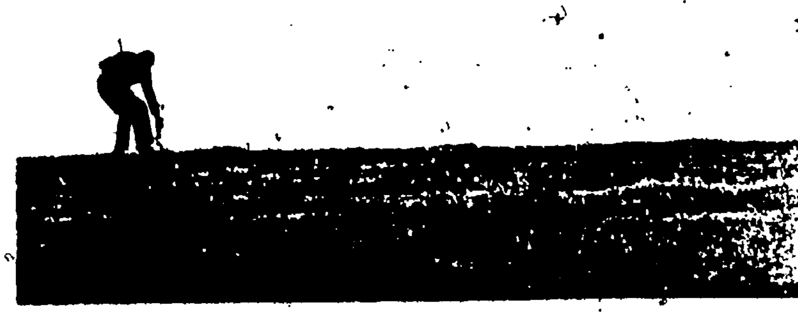
Schumacher wrote another more philosophical book called "A Guide for the Perplexed". It might be said that ON THE EDGE OF THE FOREST represents that side of his interests, whereas AS IF PEOPLE MATTERED follows his economic ideas as outlined in "Small Is Beautiful".

*"Revealing scenes of plants and animals stress their interaction and the need for all forms of life to support one another. Motion pictures of machine-ravaged forests, which Schumacher describes as formerly "like a temple", are seen to be like a scarred battlefield with the enemy being the religion of economics desiring to turn everything of value into cash...A highly effective, beautifully photographed film. Recommended for all ages."*
Landers

*"An appealing summary of some of this popular economist's ideas...an appropriate selection for environment and economic classes in junior high school through colleges as well as for public libraries."* Booklist

**32 Minutes**
Environment
Social Studies
Economics
Values

Grades 7 to Adult
*Honorable Mention,*
***Columbus Film Festival, 1980***
***Midwest Film Conference, 1980***



# or more information...films

he following films are suitable for general interest audiences and may e borrowed, rented, or purchased for use by schools, libraries, or community organizations.

**unbuilders** 16mm, 20 minutes.

Explores the progress and potential of passive design through interviews ith builders and owners of passive homes throughout the country. ee loan Regional Solar Energy Centers and Department of Energy Film Library, Technical Information Center, P.O. Box 62, Oak Ridge, TN 7830. Purchase: National Audiovisual Library, General Services dministration, Washington, DC 20409 (Stock A-02139).

**WATER**—27 min. color. This award-winner explores both the esthetic and practical use of water. It encourages its wiser use and reuse. It covers hydrologic cycle, water chemistry, pollution, irrigation, conservation, industrial and domestic use. Animation, spectacular photography and original music heighten the story. Multi-award winner. *Available to 7th grade & higher.*
*#3830* MORTON SALT COMPANY

**THE ROAD TO ENERGY, U.S.A.**—29 min. color. This film, starring Bob Hope, takes the viewer down many roads to visit people whose efforts help supply and conserve energy in the United States.
*#31142* TEXACO INC.

**"WHEN THE CIRCUIT BREAKS"... AMERICA'S ENERGY CRISIS**—29 min. color. How did America's energy crisis happen? And how can we meet the challenge it poses? This film focuses on the need for America to develop its domestic resources of coal, oil and natural gas and the need to investigate the promise of geothermal, nuclear fusion and solar energy as future sources. Above all it stresses the immediate need to conserve all forms of energy.
*#30770* FEDERAL ENERGY ADMINISTRATION

**FILM LIBRARIAN**
**TENNESSEE GAME & FISH COMMISSION**
**ELLINGTON AGRICULTURAL CENTER**
**P. O. BOX 40747**
**NASHVILLE, TENNESSEE 37220**

**MODERN TALKING PICTURE SERVICE, INC.**
LM SCHEDULING CENTER
323 New Hyde Park Road, New Hyde Park, N.Y. 11040

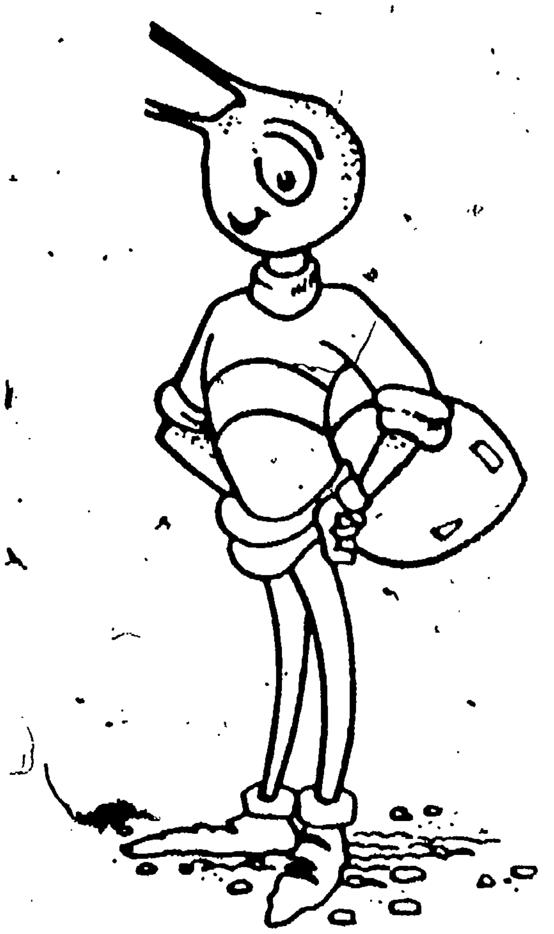
**CONSERVING A HERITAGE**
**16mm Sound-Color 16 minutes**
e oil industry attempts to demonstrate that oil and ildlife are compatible when oilmen and conservationists exercise understanding and responsibility. Habitat ement following drilling results in an increase life. Some excellent footage on the Whooping and many other wildlife species is shown.


The Tennessee Department of Conservation's Division of Educational Services offers Tennessee residents free use of films from its free-loan library.

These films are exceptional educational tools for teachers of all school levels and are entertaining for science club meetings or other interest groups.

"Home" is one of the many films offered by the division. The film depicts the ecology crisis through [illegible] of modern pollution. "Home" presents the [illegible] of an American Indian's [illegible] love for his natural surroundings with modern man today. (Color—20 min.).

For additional information or to request a film, write or call: Film Library, Tennessee Department of Conservation, Division of Educational Services, 4711 Trousdale Drive, Nashville 37219 ([illegible]).



Energy on Film. NY State Alliance to Save Energy, 36 W. 44th St., NY NY 10036. $3. 160+ films described, with information on audience level, source, purchase and rental prices, length, availability in a second language.

**SHELL EDUCATION SERVICE**

If you would like information pertaining to the Oil Industry (Exploration, Production, Manufacturing Research, Chemical) Rock and Shell collecting, write to the address listed below. Please allow approximately two weeks for material.

Organization ____________

Name ____________

Address ____________

STORY OF PETROLEUM ☐

LETS COLLECT ROCKS AND SHELLS ☐

SHELLS WONDERFUL WORLD OF OIL

OFFSHORE ☐

ONSHORE ☐

SHELL ANSWER ☐
BOOK SERIES # 1-26

Shell Oil Company
One Shell Plaza
Houston, Texas 7700
Room 1541

A Special Film:
"Winter of 1977"
"Have We Stayed Too Long at the Fair?"
D.O.E. Film

22 **A SHELL FILM**

## This Land

41 Minutes/Color

*The evolution of the North American continent.*

More than 500 million years ago, the seas covered much of what is now North America. The film traces the development of the continent from a lifeless expanse of rock in Pre-Cambrian times until the coming of man.

By a skillful blending of animated maps, sequences showing natural processes and panoramic landscapes, and museum dioramas, the building of the continent and the development of life are depicted. The film also explores the vast natural resources of North America—precious metals and rare minerals, coal and oil and how they were formed.

"This Land" looks at the building of our continent from the viewpoint of science, giving some insight into the ways geologists have been able to reconstruct and make sense of events that occured beyond the reach of human history.

*wall chart available*

1433 Sadlier Cir W Dr Indianapolis, Indiana 46239

## Selected Informational Sources For Conservation In The Home

Tennessee Energy Authority (TEA)
Suite 707
Capitol Boulevard Building
Nashville, TN 37219
Hot Line 1-800-342-1340

Request Conservation In The Home Materials and a copy of Ideas And Activities For Teaching Energy Conservation, Grades 7-12.

Tennessee Valley Authority (TVA)
TVA Citizens Action Center
400 Commerce Avenue
Knoxville, TN 37902
Hot Line 1-800-251-9242

Request "Electric Savings" and conservation material.

Department of Energy - Technical Information Center (DOE - TIC)
Citizens Assistance Section
P. O. Box 62
Oak Ridge, TN 37830
615/576-1301

Write for "Citizens Awareness Publications," EDM-350 (February 1980) and a copy of Energy Conservation In The Home.

Consumer Product Safety Hotline
5401 Westland Avenue
Bethesdan, MD 20207
1-800-638-8326

Provides information and takes complaints on product safety.

Energy, Environment, and Resources Center
The University of Tennessee
329 South Stadium
Knoxville, TN 37916
615/974-4251

Request a free publications list. For $.75 they will supply you with an excellent home conservation source telling how to obtain many free conservation publications. Request EERC/IEP 36, "Bibliography of Energy

# ENERGY EDUCATION PROGRAMS

Nashville Electric Service - Is Your Company

To schedule the following programs, contact Jean Howse at Nashville Electric Service by calling 747-3865 between the hours of 8:00 and 5:00 P.M., Monday through Friday.

## Primary Level

"Alice in No Energyland" (Grade K-3)

In this imaginative storybook, Alice travels with Rabbit to "No Energy Land" and discovers what could become of her lifestyle if she continues to waste energy. Students will enjoy learning how to conserve energy at home and in the classroom with energy conservation activities provided for the teacher.

## Elementary Level

Count Kilowatt (Grade 4)

This 17minute entertaining film depicts a magician that performs magic for Jody and T. J. and reveals to them how energy is being wasted throughout their home. Each student will receive a Count Kilowatt comic book. A take home energy survey activity is returned to teacher and the student is presented a Count Kilowatt Certificate and Badge.

## Junior High Level (Grades 5-8)

"Saving Energy at Home"

Skyrocketing utility bills can be a result of wasted energy in your home. This helpful 30 minute slide program pinpoints common areas of energy waste and offers students a variety of inexpensive solutions - from changing thermostat settings to varying cooking habits to making minor home repairs.

"Reading Your Electric Meter Can Be Fun"

Electric Meter demonstration explains when the meter is in motion, money is being spent. Also, gives helpful hints on proper use of small electrical appliances and cost to operate.

## High School Level (Grades 9-12)

"Solar Energy Today"

One alternative energy source being explored widely today is energy from the sun. This 30-minute slide presentation reveals the variety of ways that the sun's energy is being harnessed for everyday use. Locally and nationally acclaimed projects are viewed, including Solar Nashville domestic water heating project.

* Other Energy Conservation programs are in the completion stages. Additional information will be sent to you later.

**Consumer Information**
**Public Documents Distribution Center**
**Pueblo, CO 81009**
**(303) 544-6277**

*Gas Mileage Guide:* This guide gives fuel economy and other information that can help you select a vehicle to meet transportation needs and at the same time be fuel efficient. *Free.*

*Energy Saving through Automatic Thermostat Controls:* Advantages of these timing devices, types available, installation. *Free.*

*Getting the Most from Your Heating Oil Dollar:* Five-page pamphlet. *Free.*

*Tips for Energy Savers:* Hints for conserving energy in household heating, cooling, appliance use; in the workshop, and in family activities. *Free.*

*Understanding Your Utility Bill:* How to read gas and electric meters, calculate utility costs, and understand the company's billing methods and forms. *Free.*

*Gasoline: More Miles Per Gallon:* Booklet explaining how a car engine works, gas selection, maintenance tips, and driving techniques to improve car performance and lower costs. 35¢.

*Tips for Motorists:* Car maintenance and driving techniques for improving gas mileage; suggestions for curbing car use. *Free.*

**Department of Commerce**
**Washington, D. C. 20230**
**(202) 783-6200**

*Energy Efficiency Sharing:* Describes a business-to-business approach to the sharing of useful energy conservation practices and technologies. 35¢.

*SavEnergy Kit for Promoting Energy Conservation:* A promotional kit for businesses, containing sample materials that can be used in an energy conservation campaign. Single copies only. *Free.*

*Voluntary Industrial Energy Conservation Progress Report:* Issued quarterly, this publication reports on progress in energy conservation made by key energy-intensive industries. Single copies only. *Free.*

**Edison Electric Institute**
**90 Park Avenue**
**New York, NY 10016**
**(212) 573-8700**

*Energy Conservation; Experiments You Can Do:* 32-page booklet. *Single copies free.*

*Our Energy Problems & Solutions:* 45 pages; energy conservation research. *Single copies free.*

*Energy-Saving Tips for Home Lighting:* Two-page booklet. *Single copies free.*

**Exxon Company, U.S.A.**
**Public Affairs Department**
**P. O. Box 2180**
**Houston, TX 77001**

*Mickey Mouse and Goofy Explore Energy:* Comic book that can be used as an energy conservation teaching aid. *Free.*

**Harper and Row***
**Attn: Irving Levey**
**10 East 53rd Street**
**New York, NY 10022**
**(212) 593-7000**

**National Association of Manufacturers***
**Attn: Publications Office**
**1776 F Street Northwest**
**Washington, D. C. 20006**
**(202) 331-3700**

**The National Wildlife Federation**
**1412 Sixteenth Street, N.W.**
**Washington, D.C. 20036**
**(202) 797-6800**

*Conservation Directory:* 1977, 22nd edition, contains a list of organizations, agencies, and officials concerned with natural resource use and management. *$3.*

**U.S. Department of Energy**
**Educational Programs Branch, Office of Public Affairs**
**20 Massachusetts Avenue, N.W.**
**Washington, D. C. 20545**
**(202) 376-4074**

*Energy Conservation in the Home:* A curriculum guide for teachers that contains an abundance of information on energy conservation. *Free.*

*Energy Conservation Pamphlets:* "Energy Technology," "Energy Savings Through Automatic Thermostat Controls," "Tomorrow's Cars," "Waste Heat Recovery: More Power From Fuels," "Fuel Cells: A New Kind of Power Plant," and "Energy Storage." *Free.*

**U.S. Department of Energy**
**Technical Information Center**
**P. O. Box 62**
**Oak Ridge, TN 37830**
**(615) 483-8611**

*Energy Conservation Fact Sheets:* "Homes and Buildings," "Industry," and "Transportation." *Free.*

**Energy Management Section**
**General Motors Corporation**
**3044 W. Grand Blvd.**
**Detroit, MI 48202**
**(312) 556-2072**

*Industrial Energy Conservation—101 Ideas at Work:* Booklet containing a representative selection of energy conservation case histories at work at General Motors. *Free.*

# For More Information

Recent publications on energy and the environment which you might find of interest:

J. M. Hollander and M. K. Simmons (eds.) *Annual Review of Energy*, Vol. 1 (Palo Alto, California; Annual Reviews, Inc. 1976).

Allen Hammond, William Metz and Thomas Maugh, *Energy and the Future* (Washington: American Association for the Advancement of Science, 1973).

U. S. Council on Environmental Quality, *Energy and the Environment* (Washington: U. S. Government Printing Office, 1973).

Congressional Quarterly, *Energy Crisis in America* (Washington: Congressional Quarterly Service, 1973).

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P. H. Abelson (ed.), *ENERGY: Use, Conservation, and Supply*, (Washington: American Association for the Advancement of Science, 1974).

*Science* (Vol. 184), April 19, 1974 (Special issue on energy).



These organizations can furnish information about energy. Most provide books and other materials, films, and speakers on request.

**American Gas Association**
1515 Wilson Boulevard
Arlington, Virginia 22209

**American Petroleum Institute**
1801 K Street, N.W.
Washington, D. C. 20006

**American Public Power Association**
2600 Virginia Avenue, N.W.
Washington, D. C. 20037

**Atomic Industrial Forum**
7101 Wisconsin Avenue
Washington, D. C. 20014

**Ecology Forum**
124 East 39th Street
New York, New York 10016

**Edison Electric Institute**
90 Park Avenue
New York, New York 10016

**Energy Information Center**
505 King Avenue
Columbus, Ohio 43201

**National Audubon Society**
1130 Fifth Avenue
New York, New York 10028

**Sierra Club**
1051 Mills Tower
San Francisco, California 94104

**U. S. Department of Energy**
Office of Public Affairs
Washington, D. C. 20585

**U. S. Department of Interior**
18th and C Street, N.W.
Washington, D. C. 20240

**U. S. Environmental Protection Agency**
401 M Street, S.W.
Washington, D. C. 20460

WE HAVE MET
THE ENEMY-
AND HE IS US.
-pogo